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NARROW-LEAF—A VIRUS DISEASE OF TOMATOES.

PRELIMINARY INVESTIGATIONS.

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SPECIMENS of tomato-plants, exhibiting symptoms which differed from those of any of the then known tomato diseases occurring in New Zealand, were received in January, 1933, from Gisborne and Hastings. Since, on a search through the available literature, no description could be found of a tomato disease showing similar symptoms, it appeared probable that the disease had been hitherto unrecorded. The name "narrow-leaf" is suggested for the disease on account of the characteristic narrowing of the leaves.

During the summer of 1933 narrow-leaf became very prevalent in and about Gisborne, and in two commercial gardens, one within the town itself and the other at Hexton, about five miles distant, 50 per cent. infection was recorded. The disease was again present in the Poverty Bay and Hawke's Bay districts during the 1933-34 season.

SYMPTOMS.

The symptoms of the disease in the field and the glasshouse are very similar. In the field the plants may become infected at any stage of growth, but the symptoms frequently appear between the setting of the first and second trusses of fruit. The first symptom of the disease is a distinct narrowing and a slight crinkling of the young leaves (Figs. 1 and 2). As the infected plants grow, the leaf symptoms become more pronounced and, in severe cases, the leaves become much curled and distorted (Figs. 3 and 4). Leaves which are fully developed at the time of infection remain unchanged (Fig. 1). The upward growth of the infected plants is usually not greatly retarded, but the leaf area is reduced (Fig. 4), and the fruit is invariably smaller than the normal, inclined to be flattened, and of light weight. Sometimes growth is much retarded, and fruit fails to set on trusses formed after infection has taken place. Under favourable growing conditions instances of partial recovery associated with setting of fruit on the upper trusses have been reported from the field. This was also observed in the glasshouse.

DETERMINATION OF CAUSE.

From a consideration of the symptoms and the rapidity of its spread in the field, it seemed probable that the disease was due to a virus. In order to test this an attempt was made to transmit the disease from infected to healthy plants by means of juice inoculations.



FIG. 1. NARROW-LEAF OF TOMATOES.

The plant on the left shows symptoms which are characteristic of the disease in the early stages of infection. Normal plant on right. Glasshouse-grown plants of the same age.

[Photo by H. Drake.]

Experimental Method.

For the original inoculations, infected plants were secured from the field at Gisborne. In all subsequent experiments diseased material from the glasshouse was used. The leaves from an infected plant were ground in a mortar and the juice strained through muslin. Healthy plants, usually about 8 in. tall, were inoculated by rubbing

the leaves with muslin moistened with the above juice extract. This rubbing was sufficient to break the leaf hairs and to cause tiny scratches, thus allowing the juice to come in contact with the living tissue of the leaf. All plants were grown and all inoculations carried out in insect-free glasshouses. The variety of tomato used throughout the experiments was Sutton's Best of All.



FIG. 2. LEAF SYMPTOMS OF TOMATO NARROW-LEAF.

Normal leaf on right. Leaves taken from glasshouse-grown plants.

[Photo by H. Drake.]

In Table I are given the results of the inoculations.

Table I.

Date of Inoculation.	Control.		Inoculations.	
	Number of Plants.	Number infected.	Number of Plants.	Number infected.
31st March, 1933 ..	6	0	6	2
2nd March, 1933 ..	12	0	12	4
16th March, 1933 ..	6	0	6	6
7th April, 1933 ..	6	0	12	6
Totals ..	30	0	36	18

Incubation Period.

Narrow-leaf has no definite primary symptoms, and the development of narrow leaves takes place gradually. Although the plants were examined every second or third day, it was difficult to determine when the symptoms first became apparent. In one of the above four experiments definite symptoms were present on the thirteenth day after inoculation. In the other three experiments, however, although

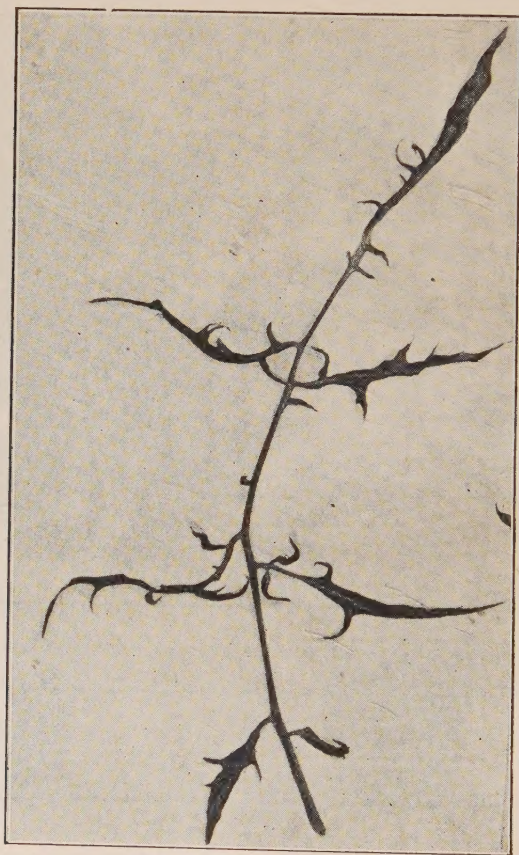


FIG. 3. TOMATO-LEAF SHOWING PRONOUNCED SYMPTOMS OF NARROW-LEAF.

[Photo by H. Drake.]

certain plants appeared to be slightly abnormal by about the fourteenth day, definite symptoms were not visible until eight to ten days later.

TRANSMISSION TO TOBACCO.

Of twelve healthy tobacco-plants inoculated with juice extract from narrow-leaf-infected tomato-plants, five became infected, while a similar number of check plants all remained healthy. The most characteristic symptoms of the disease on tobacco were a stunting of the plant and a

slight narrowing of the leaves (Fig. 5). The leaves of the infected plants were also slightly paler in colour than the normal, and the flowers, many of which failed to set seed, were distorted and showed pink-and-white stripes. Tomato-plants inoculated with juice from the infected tobacco-plants developed typical symptoms of the disease.



FIG. 4. NORMAL (LEFT) AND NARROW-LEAF TOMATO-PLANTS.
Plants of the same age grown in the glasshouse.

[Photo by H. Drake.]

TRANSMISSION BY APHIDES.

Healthy tomato-plants grown in 6 in. porous pots in an insect-free glasshouse were covered when 5 in. to 6 in. tall, with muslin cages as described by Cottier.* The aphides, bred on healthy *Solanum nigrum*

* Cottier, W. 1931: "The Transmission of Virus Diseases of Potatoes by Insects. Leaf-roll." *N.Z. Jour. Sci. & Tech.*, 13, 85-95.

plants, were allowed to feed on infected plants for one week before they were removed to small squares of paper which were placed on the caged tomato-plants. The aphides soon migrated to the leaves of the healthy plants where they were allowed to feed for a given time before they were destroyed by fumigation with nicotine sulphate.



FIG. 5. NARROW-LEAF INFECTION OF TOBACCO-PLANTS.

Normal plant on right. Plants of the same age grown in the glasshouse.

[Photo by H. Drake.]

Inoculations with juice extract from each of the two plants infected through transmission by *M. pseudosolani* reproduced typical symptoms on healthy plants. Although the number of plants used in the experiments were not sufficient to give conclusive results, it was at least shown that the aphid *M. pseudosolani* is capable of carrying the disease.

The details of the experiments are given in the following table :—

Table II.—Transmission of Narrow-leaf by Aphides.

Species of Aphis.*	Control.		Aphis Transmission.			
	Number of Plants.	Number infected.	Number of Days Aphides fed on Plants.	Number of Aphides added per Plant.	Number of Plants.	Number infected.
<i>Myzus persicae</i> ..	4	0	10	21	4	0
<i>Myzus persicae</i> ..	4	0	24	24	4	0
<i>Macrosiphum gei</i> ..	4	0	19	10	4	0
<i>Myzus pseudosolani</i>	5	0	19	12-15	7	2

* The identification of the aphides used in these experiments was made by Mr. W. Cottier, Assistant Entomologist, at this Station.

REMEDIAL TREATMENT.

Control measures should be along the lines of those adopted for similar virus diseases.

Growers should raise their own seedlings.

All infected plants should be removed immediately the disease makes its appearance.

The hands should be washed thoroughly with soap and running water after handling infected plants and before working with healthy ones.

SUMMARY.

(1) An apparently hitherto unrecorded disease of tomatoes has appeared in two districts of New Zealand.

(2) The most outstanding symptoms are: Narrowing and curling of the leaves, with subsequent reduction in leaf area. The fruit fails to set, and the yield is very much reduced.

(3) The disease, for which the name "narrow-leaf" is suggested, has occurred to the extent of 50 per cent. in some commercial gardens.

(4) Successful transmission of the disease by artificial inoculations indicate that it is due to a virus.

(5) Experiments have shown that the aphid *Myzus pseudosolani* is a vector.

(6) The disease is also capable of infecting tobacco-plants.

ACKNOWLEDGMENTS.

The writer wishes to acknowledge the help given by Mr. Everett, Orchard Instructor at Gisborne, who kindly supplied diseased material and from whose notes descriptions of field symptoms were largely drawn. Thanks are also due to Mr. Adamson, Orchard Instructor at Hastings, who forwarded diseased material from his district.

The potato crop (Auckland Short Top, Dakota, Kerr's Pink, and Game-keeper) grown on a salty area, Napier Village Settlement, has proved to be of splendid eating quality, being very floury when cooked. This is contrary to expectation, as an over-abundance of salt in the soil has been considered to cause soapiness and poor quality.

LINCOLN PURE-SEED STATION.

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THE objectives of the Station and its establishment have been detailed in a previous article (*Journal*, Nov., 1932.) It is unfortunate that a normal season has not been experienced since the work commenced. The winters of 1932 and 1933, the latter especially, were abnormally dry. These were in turn followed by dry spells in the spring and summer, resulting in checked growth, and only average, or below average, crops. Unseasonable frosts have been experienced, and the effect of these has been evident on the potato and the pea crops, and to a lesser extent on the wheat. The present winter has so far been very wet, and work has been delayed in consequence, but a good reserve of moisture in the subsoil for the coming summer is at least assured.

The rotation adopted originally—cereals, potatoes, peas, green-manure—has worked out very well in practice. Ample time is allowed for the thorough preparation of the land between each crop, and the beneficial effects of the green manure are already apparent in the better growth of the crops and the mellower nature of the soil when compared with the unmanured ground. Italian rye-grass has proved quite satisfactory for green manuring. With the object, however, of deriving the additional benefit of a legume, blue lupins, and a mixture of blue lupins and rye-grass, are being tested out.

One change worth recording concerns the subdivision of the farm. Previously it was divided into four areas of 11 acres and one of 8 acres. The whole farm has now been laid out in blocks of from 1 acre to 2 acres. Each block is worked on the four-course rotation, and the cropping is so planned that each area of wheat, potatoes, &c., is separated by at least three blocks from the nearest area of the same crop. As far as possible the policy of "one area one variety" is adopted. Although the system has been tried for only one season, its advantages have already been apparent. A strong north-west gale was experienced shortly after the peas were cut. Had all the varieties been growing side by side the result must have been the loss of the whole crop through mixing. With wheat the danger of stray straws being carried off the binder fans into an adjoining variety is removed, and by having the varieties so widely separated the danger of natural crossing is greatly reduced. In any crop there is now the possibility of checking the spread of disease should one variety, for some obscure reason, show an unexpected degree of infection.

The Canterbury Agricultural College authorities continue to co-operate in the matter of lending small isolation areas and in making available the use of plant and workshop facilities.

POTATOES.

The objective in view here is essentially the same as when the work commenced—viz., the isolation and multiplication of relatively virus-free lines. The spread of virus is still the major problem encountered in this work. In the previous article cited above reference was made to the appearance of odd severely infected plants, and it was suggested

that these were probably due to the transmission of disease from one variety to another. Subsequent observations have supported this view. The isolating as far as possible of one variety from another was carried out, and, although this has been practised only in two seasons, the number of badly diseased plants has been so greatly reduced as to indicate that the problem is well in hand. The system of separating widely each variety from its neighbour, as already mentioned, should prove a further step forward in respect to the control of the spread of virus trouble.

Some progress has been made in reducing the number of varieties. A number of doubtful merit have been discarded, but there still remain a dozen for which there is a demand for seed and which possess features that make them of value for specific situations. Much merit relatively



FIG. 1. SHOWING THE LAYOUT OF THE WHEAT-BREEDING PLOTS.

In centre, nursery-beds of single-plant selections; in foreground and distance, single-row multiplication plots surrounded by "bulk" of the same variety.

attaches to the old-established varieties such as Dakota and Aucklander Short Top for Canterbury, and Arran Chief and King Edward for further south. Arran Banner, of which much was expected after preliminary trials, has proved disappointing. This is in part due to the fact that it has been grown in many cases on heavy land on which it produces very coarse tubers, and in part to the fact that without sufficient attention to the seed stocks it degenerates rather rapidly. Arran Consul is a variety well worth further trial where a white-skinned, good-keeping potato is desired. All efforts to raise a healthy line of Up-to-date have failed, largely owing to its extreme susceptibility to stipple-streak. It is interesting to note that in New South Wales, where this variety, under the name of Factor, is one of the most popular, the disease is unknown.

With the additional shed accommodation it was possible last season to green and sprout the seed. The advantages were at once apparent in an earlier germination and a stronger and more even stand. An outstanding feature was that such bad cutting varieties as Aucklander Short Top and Majestic stood cutting remarkably well when greened and sprouted.

Problems of seasonal occurrence have been attacks of eelworm (*Heterodera marioni*) and potato-moth (*Phthorimaea operculella*). The former was extremely severe in 1931-32. Trials have been laid down to ascertain, if possible, information on conditions influencing the distribution and severity of the attack, but infection is so spasmodic as to render such work very difficult. In the meantime all the available information is being accumulated. The dry season and the dry open

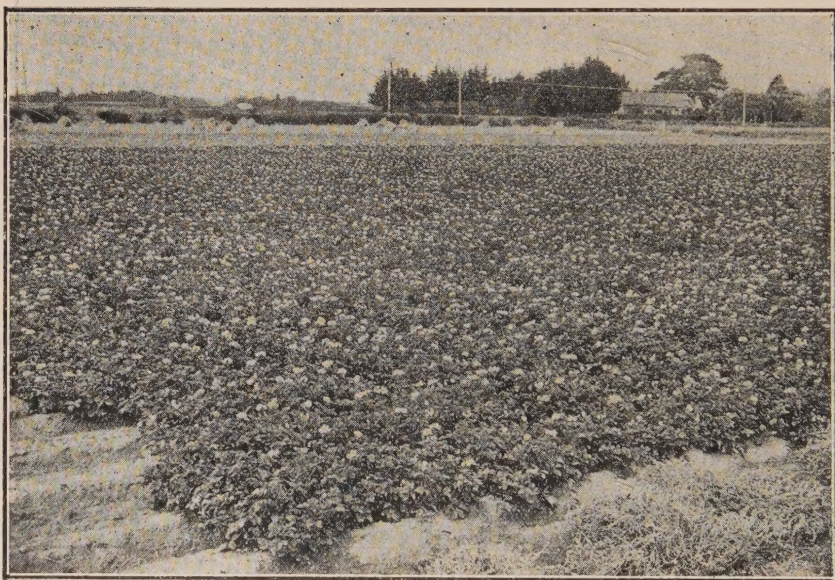


FIG. 2. IRON DUKE POTATOES.

nature of the ground in the summer of 1932-33 appeared to favour a heavy infestation of potato-moth. The pest may be checked by a deep mould, but in the season in question infected tubers were found 3 in. below the surface.

Seed has been distributed each season, orders being received from all parts of New Zealand. With most varieties the demand exceeds the supply. Samples are freely submitted for variety identification.

WHEAT.

Work in building up and maintaining the main commercial varieties has been continued. The popularity of many of these is on the wane, and rightly so, since it has been shown that varieties like Tuscan and Hunters will give equal, if not better, yields under the same conditions.

Seed stocks are held and kept alive at the Station, and should a demand arise an area can be sown to meet requirements. What appears to be a superior line of Solid Straw Tuscan has been isolated, and trials are being carried out this season in the wheat-growing districts to determine its merits. Re-selection within Hunters II in an endeavour to obtain a more even line is proceeding. From the mass of material originally under observation seven lines now remain on trial. A limited, but nevertheless consistent, demand for seed of the Dreadnought variety comes from the Oamaru district. The Station selection of Dreadnought is steadily replacing the old strain on account of the superior yield of the former, and seed is distributed each season. Since the variety Jumbuck came into prominence, work has been commenced in building up a pure line. Owing to the very heterogenous nature of the original



FIG. 3. SHOWING THE ROTATION.

In the foreground, peas; then potatoes; then wheat.

material, only partial success has been attained up to the present. Some foundation material has been selected with a view to putting out a pure line of Cross 7 when the present seed becomes too impure.

Since all the nursery rows and propagation plots of any one variety have been grown within the bulk area of that variety the amount of natural crossing has been greatly reduced. By separating the varieties several chains from each other it is hoped to reduce such crossing to a negligible minimum.

To control loose smut the seed sown in the final "increase" blocks is hot-water treated, and a plant has been fitted up at the Station for the treatment of small lots. No details of its efficiency in controlling the smut are yet available, but the germination of treated samples appears to be very satisfactory.

PEAS.

During the past season the work with garden peas reached the stage which has been the aim since its commencement in 1927-28—viz., the distribution to merchants for further growing in New Zealand of nucleus lines of seed. Twelve acres were sown with thirteen varieties, and all the seed except one small line was disposed of.

The occurrence of tare-leaved rogues presents the major problem in the work. The origin of these plants is obscure, but they occur and multiply despite the greatest care and attention. This season three varieties had to be discarded on this account. A definite project of the near future will be a study of the problem in an endeavour to ascertain the underlying causes, with a view to making selections, if possible, along other lines.

Other problems concerned the handling of the crop. Harrowing with light sharp harrows every four or five days, from the time of sowing until the peas were 6 in. high, was very effective in controlling weeds. Altering the mower so that additional tilt could be given to the knife allowed harvesting to be carried out without losing any pods.

The work with field peas received a set-back when it was found that the selections raised were very little, if any, better than commercial lines. Examination of past records suggested that the original range of materials was too narrow to hope for any outstanding variations. As a result, a new start has been made, and as wide a range of samples as was possible has been collected and grown for preliminary observation.

LINSEED.

Owing to the press of other work, and also to the fact that under present market prices linseed has greatly waned in importance as a crop, this work has been restricted. Trials have been continued with the most promising local selections of the Moose variety and with imported lines. From the material on hand it should be possible to shortly put out an improved strain.

OATS.

Preliminary work covering the investigation and classifying of the varieties grown in New Zealand was carried out at the Plant Research Station. A detailed report of this work has recently been published in this *Journal* (May, 1934). Last season single plant selections of a number of varieties were received at Lincoln for trial under local conditions and for building up pure lines. The more important varieties will be increased as rapidly as possible. Others of less importance will be treated similarly to the wheat varieties—i.e., seed stocks will be built up and held over until a demand arises. The outstanding feature of the work so far is the promise given by the variety Lampton, imported from New South Wales. Although a little coarse in the straw, this variety has given good yields of grain and chaff, and appears resistant to smut. Further material of similar breeding, along with seed of several other varieties, has been received from the New South Wales Department for trial this season.

MISCELLANEOUS.

An area of $4\frac{1}{2}$ acres was sown down last season with a strain of white clover raised by the Agrostologist. Although checked by the dry

season, this is now well established, and a seed crop should be harvested next summer. A small grass garden has been laid down, comprising typical strains of the grasses of chief importance economically.

With the object of producing nucleus stocks of pure lines of rape a number of strains raised at the Plant Research Station have been sown in nursery-beds, and will be transplanted in the spring.

Since the work started definite progress has been made. Seed is distributed regularly to farmers, and, as the resultant seed usually proves eligible for official certification, it becomes available to a much wider range of growers. Local problems concerning the handling of the various crops have been overcome, and the original objectives have become clarified, and, if not simpler, at least better understood.

THE FIBRE TYPES OF NEW ZEALAND ROMNEY SHEEP.

THE PRACTICAL BEARING OF PRESENT KNOWLEDGE.

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IN recent articles there have been presented somewhat detailed accounts of the fibre types of the Romney lamb. These details it has all the time been the endeavour to interpret in terms of the forces at work in the growing fleece, but the practical bearing of the facts and ideas that have emerged has not been forgotten. If this story of the coat of the lamb was to be related at all, it had to be rather a complicated one in order to give the evidence for the conclusions drawn. The purpose now is to give a summary of the points which the breeder might keep at the back of his mind or in his mind.

THE VIEWPOINT OF THE RESEARCH.

First may be explained the viewpoint from which this research has been conducted. The work has practical aims, but these have in considerable measure been kept in the background. Previous experience of research involving the breeding of sheep has been of less help than knowledge of the structure and growth of the hair of mammals gained in the study of the coats of small animals and from the published work of investigators who were often not concerned at all with wool. Stimulating ideas have also been seized upon from researches on the coats of sheep in other countries, especially those of Duerden and Fraser Roberts. Thus was it known for what kind of facts to search about the structure and development of the units of which the coat is composed.

The Early Detection of Fleece Characters.—While the knowledge gained may be counted upon to prove useful, directly or indirectly, in many practical ways, it should be explained at the outset how research associated with animal breeding may reasonably be expected to assist the breeder quickly. Some characters, it is true, such as horns, colour, colour patterns, or gross defects like the absence of teats or of external ears, are inherited in simple fashion, so that breeding on

Mendelian lines may give rapid, clear-cut results. Such features, however, rarely make the problems that engage the perennial attention of the breeder.

Most features of economic importance are not inherited in a simple manner. We are unable, for example, to detect separately the numerous genetic factors that determine fertility, milk-yield, or wool-count. All the same, selection in a desired direction is very largely effective. Down the ages selection has been the supreme instrument of the animal-breeder, and until the science of genetics, rapidly growing but youthful, has attained greater maturity one of the best services of the research worker will be to sharpen this powerful weapon, simply by aiding the discrimination of the breeder, thus making selection more certain, more accurate, or more rapid. This is the chief direction in which the study of Romney fibres is likely to find speedy application, in assisting the "measurement of excellence" in Crew's phrase, or the detection of faults, and in enabling us, moreover, to foretell in the early months or weeks of life the nature of the fleece at later ages.

Further Problems of Selection.—The methods of selection just mentioned may entail careful observation at a defined time, but there is no great subtlety in prophesying the hairiness of a later fleece from the hairiness at four months. In other problems of selection we seek to discover something that cannot be detected in so straightforward a manner.

There is a problem of this sort connected with kemp about which more is to be said later. We are able to say for lambs with no halo-hairs on the back at birth—and with no chance to grow kemp later—whether or not the growth of kemp would have been sustained had halo-hairs been present. From the point of view of breeding for the suppression of kemp some no-halo animals would therefore be better than others.

There is an unsolved problem of the kind under discussion in non-kemp hairiness. There is reason to believe that some lambs free from non-kemp hairiness have escaped hairiness by a safer margin than others, and are therefore more desirable for breeding. How to judge non-hairy animals from this point of view we do not yet know.

A Basis for other Researches.—The recognition of the different kinds of fibres composing the fleece supplies a necessary basis for extending our knowledge in a number of directions. We are better able to plan and interpret not only breeding experiments, but work upon the effects of differences in nutrition and in environmental conditions.

HAIRINESS.

Two Kinds of Hairiness.—Two kinds of hairiness are recognized, kemp and non-kemp. Kemps are fibres that grow for a definite, limited time, and are shed sooner or later after completing their growth. Belonging also to this first kind of hairiness are those hairy fibres that are not shed, but are of indeterminate growth, that are produced in follicles that have previously given rise to one or more kemps. Hairy fibres of the non-kemp group are those of indeterminate growth which are the first occupants of their follicles; secondly, in this group are also included fibres which are of very little importance

in a hogget fleece growing normally and which cease growing after a different time from kemps, and often in a recognizably different manner; thirdly, there are fibres which are presumed to succeed the last in the same follicles. It appears indeed not far from the truth to regard non-kemp fibres as growing indefinitely unless something in the nature of an accident befall them, whereas cessation of growth is an essential feature of a kemp.

In considerable measure the two kinds of hairiness vary independently, although there is some connection between the two, and this perhaps greater than has hitherto been thought. The lambs so far studied with the coarsest non-kemp hairiness on the back have all had halo-hairs abundant there; of no-halo lambs so far examined some have shown marked non-kemp hairiness, but such hairy fibres have not been very coarse. It would also appear a significant fact that in considerable measure the hairiness of persistent fibres succeeding birthcoat kemps in the same roots parallels that of the coarsest non-kemp fibres. This matter of the relation of kemp and non-kemp hairiness merits close investigation. It is important, nevertheless, to be on the lookout separately in the lamb's coat for the two kinds.

Recognition of Kemp Hairiness in the Lamb's Coat.—Large birthcoat kemps, or halo-hairs, project above the rest of the coat at birth, and may still be recognized very readily at docking-time. It has been suggested that selection against these should be as keen as is practicable, with attention paid especially to the back and britch.

There are great differences between lambs in the hairiness of the fibres which follow the shed halo-hairs in the same roots. Some understanding has been attained of how these differences come about, as has recently been reported in a preliminary account. The fibres succeeding halo-hairs are most objectionable when they are kemps—and a series of kemps may follow one another in the same follicle—or grossly hairy fibres of persistent growth. On the other hand, where there is little or no non-kemp hairiness, it can come about, in certain definite conditions, that the hairiness of the successors of halo-hairs is slight, or negligible, or perhaps even zero.

It is conceivable that in some breeding projects it might be a commendable policy to breed for freedom from hairiness in the successors of halo-hairs rather than to select against halo-hairs themselves, and in such a situation the facts that have lately come to light would be useful. In the Romney selection against halo-hairs is simpler.

At the present stage of our fight against hairiness it is hardly necessary to select separately against the slimmer birthcoat kemps—mostly sickle-fibres—that finish growing about the same time as halo-hairs. Very largely these fibres will be detected in benzol-testing at times appropriate for judging non-kemp hairiness.

It will be recalled that hairy sickle-fibres may or may not be shed, and that they are shed in very varying proportions, though it is unlikely that all such shed fibres would be lost from the coat. If halo-hairs are present on the back in more than the paltriest numbers, then we know that sickle-fibres (all hairy, or some hairy and some fine after birth in different fibre-type arrays) are plentiful. In many lambs with no halo-hairs on the back there are none of the slimmer birthcoat

kemps, but they may be plentiful, so that it may eventually prove worth while to keep a watch for these fibres in no-halo lambs by benzol-testing at about ten weeks.

If the abundance of halo-hairs had not been noted before they fell out, it would be well to keep a watch later on, if specimens were examined in benzol, for possible very hairy successors which begin to grow about the third or fourth months and which may therefore be very prominent in benzol in a six months' sample.

Recognition of Non-kemp Hairiness in the Lamb's Coat.—Assuming the lamb to be growing normally, if non-kemp hairiness is going to make its appearance it can be recognized, in fibres which mostly appear entirely innocent when the lamb is born, when growth has continued for a very short time after birth. Generally this hairiness is in evidence in the first few days of life, but if we allow three weeks in a lamb that is developing reasonably well, and then find no non-kemp hairiness, we may accept any such portions of the fleece as free for the first year, and, in all probability, though experience here is limited, in later fleeces.

On present knowledge we are not able to foretell how far down the staple hairiness will be sustained. We can only wait and see. The age of two months, as will be more apparent directly, is an important date. It is about this time that any sickle-fibres and allied types that are to be shed have finished their growth. This level is called the crisis level, for it is a critical time in the career of such fibres, which may or may not be shed. A hairy fibre that persists may go suddenly thin at this point, often recovering its coarseness, after being thin for half an inch or a little more, instead of shedding. If non-kemp hairiness ceases definitely above the crisis level, then this hairiness has not been found to be renewed before shearing-time when the animals are a little more than a year old. If non-kemp hairiness should cease at or below that level there may, or may not, be a revival of hairiness at some time later in the growth of the first fleece.

Relation in Kemp Hairiness between the Fleeces of the First and Later Years.—There is substantial evidence that kemps grow later in the first fleece only when birthcoat kemps are present, and in the extensive material studied any kemp that can have grown later—"secondary kemp," so-called—in the follicles of anything but the biggest birthcoat kemps—that is, the halo-hairs—has rarely amounted to anything.

Similarly, kemp has been found in later fleeces only when secondary kemp has grown in the first fleece. Sometimes an animal with much secondary kemp in the first fleece has continued to grow plentiful kemp in subsequent years. Sometimes kemp has become clearly less plentiful in later fleeces, presumably because kemp follicles have changed over to producing fibres of persistent growth. Whether such follicles, after sustaining the growth of one fibre for a long time, can halt again and revert to putting forth kemps, which grow for something like a couple of months only, has not been determined.

Persistent fibres succeeding halo-hairs are often outstandingly objectionable hairy fibres in the first fleece, and it is probable that they are similarly prominent in later fleeces. Individual fibres have not yet been followed through from one fleece to another, but at the revival of hairiness following suspension of medulla formation in the winter these persistent occupants of kemp follicles have been conspicuous for early restoration of medulla and for coarseness.

Relation in Non-kemp Hairiness between the Fleeces of the First and Later Years.—Preliminary studies have been made by examination by eye of specimens in benzol from a standard position on the side, this being the region from which specimens have most consistently been preserved. The indication is, apart from an exception to be discussed directly, that the abundance of hairy fibres of the non-kemp group is much the same in each of the first four fleeces. It is to be noted that the later fleeces may be the coarser, and their hairiness more readily detected by eye, and medulla may be better sustained towards the butt of the staple. This is probably the explanation of the statement by breeders that the third fleece may be badly hairy after the animal has been thought good enough on the first two fleeces. If we may generalize from the observations now under consideration, examination in benzol reveals the true situation in the two first fleeces where, as has happened to me, it has not been realized from inspection how hairy they were.

When medulla on the back or side in the first year's fleece does not extend below the crisis level, then in the same part of the next fleece there may be less medulla or none at all, and then the third fleece also has been free. The reduction may be greater on the back than on the side. Parallel results are recorded by Mr. Rudall from studies of the effects of shearing lambs at about three months and a half.

How now are we to regard the position just stated? There are alternative viewpoints. On the one hand, we may be lenient to such animals, and make allowance for early error in a lamb which in after-life mends its ways. From the practical standpoint this is probably the right attitude in flocks where quite a measure of hairiness must be permitted in order to retain enough breeding-stock. On the other hand, we may regard this touch of hairiness in the early days as revealing the unsatisfactory hereditary endowment of an animal which would show up splendidly on the benzol-testing of later fleeces. More will be said on this point shortly. This second attitude may well prove the ideal one to adopt in judging rams.

Inheritance of Kemp Hairiness.—The abundance of halo-hairs is strongly inherited. Selection for many halo-hairs on the back, or for freedom from halo-hairs there, has proved largely effective, and especially, so far as the experiments have gone, has the selection of animals entirely free from halo-hairs on the back. At the same time, offspring may have fewer halo-hairs than their parents, and parents both with moderate numbers of halo-hairs, or even both with few halo-hairs (1934 season), have produced lambs with many halo-hairs.

With regard to the successors of halo-hairs, a lamb is to be reported with many of these successors kemps, and with kemp continuing to be grown later in the first fleece, whose parents both had few kemps amongst the successors of halo-hairs. Again, it is to be emphasized that the way to avoid complications in kemp hairiness, interesting though they be from physiological and genetical points of view, is to select hard against birthcoat kemp.

Inheritance of Non-kemp Hairiness.—Here the experiments performed have been of but a rough sort, but, as breeders will readily believe, they point to the great importance of inherited factors. Some lambs were more hairy than either parent, a fact which again will cause no astonishment.

Non-genetic Factors and Hairiness.—In simple shearing experiments (R. Waters, K. M. Rudall, and myself) in which an animal has been treated differently on parts of the body which could fairly be compared, differences in hairiness have been produced. The probable explanation is that when the skin is kept warm this tends to less hairiness, while the response of the skin to cold tends to more hairiness. Here we see the influence of physical conditions.

In these shearing experiments it has been found how delicate is the balance which determines whether wool be hairy or not. By leaving $1\frac{1}{2}$ in. of wool, instead of shearing close in the ordinary way, hairiness has largely been suppressed in slightly hairy animals. Again, for example, Mr. Rudall has shown the effects of shearing sometimes to extend a little way into the adjacent unshorn area, gradually tailing off there; and the converse also happens. The significance of details like these for the fundamentals of our fight against hairiness will be discussed directly. Here may be expressed my personal preference, in the light of the facts just reported, for attaching in selection proportionately more importance to variations in the hairiness in the tip of the staple grown just after shearing, when conditions are generally the most favourable for medulla formation, than to variations in the distance down the staple to which hairiness extends.

Nutrition also has its effect on hairiness, in that a number of slightly hairy lambs growing poorly showed temporary reduction in non-kemp hairiness and in fibre diameter at growth stages at which comparable lambs show no such reduction. The temporary reduction occurred about the time when the lambs were growing exceptionally badly, in some of their early weeks, reappearing in the wool grown afterwards when they were making better progress. These facts are consistent with the view, for which there is a variety of other evidence, that hairiness is an expression of vigorous wool growth. With many animals, it is clear, good conditions tend to greater hairiness, poor conditions to less. Often little or no medulla is produced in the winter season when the staple is hairy at other levels. Hunger-fineness, however, is a poor escape from hairiness.

At the same time, the possibility is borne in mind that good conditions may produce a different effect. When hairiness is attributed to the vigour of the fibre root, this is thought to be putting out material faster than it can keratinize this fibre stuff to form the substance of pure wool. If any condition should improve the keratinizing-power of the root proportionately more than it increases the output of material, then this condition would reduce hairiness. Such a state of affairs we must be not unprepared to encounter.

The facts just reported serve to emphasize the need for investigating the effect upon hairiness of nutritional and other non-genetic factors. Such knowledge would find immediate application as an aid in judging the hairiness of animals in the selection of breeding-stock. The question of hairiness in relation to fleece-weight is, besides, by no means unimportant.

Probable Differences in Non-hairy Wools.—Mention has been made of the well-known fact that a staple may be hairy at one level and pure wool at another. It is one thing to grow pure wool in the

winter, and another thing to grow pure wool just after shearing. It will be recalled, too, that of sheep free from non-kemp hairiness in the second year some were free in the same part of the fleece in the first year, while others were somewhat hairy in their first two months. It has been explained, also, how little will sometimes tip the balance between the presence and absence of medulla.

Facts like these point to differences in pure wool in the margin by which hairiness is escaped, to differences, most likely, in keratinizing-power. Especially with fine-wooled sheep is it likely that many pure-wooled animals are not hairy precisely because the wool is fine, and that if those sheep had coarser wool, with the rest of the hereditary make-up the same, they would be hairy. If this be so, we could readily understand the appearance of hairiness, as it is stated by breeders to come to light as the result of crosses between coarse non-hairy and fine non-hairy animals. If real differences exist in what may be termed the margin of safety against hairiness, it would be highly useful to be able to detect them, for then the effectiveness of selection against hairiness would be markedly increased.

There are a number of possible avenues of attack on this problem, and mention may be made of researches that have bearing upon it. Sidey has reported differences in the sulphur content of non-hairy New Zealand wools. The Wool Industries Research Association and Sidey have shown that desirability for spinning and high sulphur content are accompanied by good circularity of cross-section. Rudall, on pulling out fibres, finds differences, between lambs that had not been hairy on the part of the body experimented upon, in the hairiness of the fibres growing afterwards in the roots from which the original occupants had been torn. Gabriel has made studies of the size and shape of the cortical cells of wools of widely contrasted breeds. The determination of the inherent tendency to hairiness of a non-hairy animal is a major problem.

OTHER PROBLEMS.

It has been usual to state the practical bearing of the study of the fibre types almost exclusively in terms of hairiness. Our friends in Britain connected with manufacturing have also much to say about evenness between fibre and fibre in length and diameter, features which are inter-connected, and evenness in diameter along the length of the same fibre. To a large extent these features are associated with differences in hairiness, and it may be pointed out without elaboration that knowledge of fibre types and fibre-type arrays is as fundamental in relation to these features about which little has hitherto been said as it is to hairiness. There are indications of differences, irrespective of hairiness, in evenness of length and diameter, and here, too, it is probable that the examination fibre by fibre of wool specimens taken at the age of two to three months will prove important. Evenness over the body in respect of these dimensional features of fibres also calls for attention, and here recent work by Miss Galpin is pertinent. She has found marked variation from animal to animal in the change over the body of the fibre-type array.

In connection with "untrueness," or unevenness in diameter along the fibre, reference may be made to the work of Mr. Waters upon growth-rate at different times of the year. In some hoggets he found an

astonishing reduction in growth-rate in length in the winter, accompanied by great reduction in diameter. Mr. Waters stresses the differences in animals of the same flock in their ability to sustain wool output in unfavourable conditions. The view that these differences between animals are in part inborn is also made probable by the varying evenness in growth-rate throughout the year reported in investigations in other countries.

The point just touched upon introduces the large question of fleece-weight. Here, again, knowledge of the times and modes of development of the different kinds of fibres composing the coat provides working capital for research upon the factors determining the weight of the fleece, or, perhaps more important, as Fraser Roberts has pointed out, the weight of wool produced in a given time by a unit area of skin.

In lambs growing badly in the early weeks of life it has been found that far fewer new fibres than normal start to grow during the time of poor progress. It is a matter for investigation whether the effects of this check to the development of the coat are ever made good. One also wonders whether anything could be done to initiate the growth of a greater number of fibre-roots early in the life of the lamb, or even before birth, when the foundation of the fleece is being laid, which might have a lasting influence upon fleece-weight.

Sidey has drawn our attention to the surprisingly large differences in the fleece-weights of animals of the same stud flock. Fleece-weight, therefore, is an important matter for investigation. There is, besides, a pleasing contrast, after contemplating attempts to correct defective features, in seeking to produce a larger quantity of wool that is already good.

SUMMARY.

The most immediate practical aim of the work discussed is to aid in selection for wool characters, and especially to save time by making it possible to distinguish between good and bad when sheep are very young.

In judging the coat of an animal in a work-a-day world observations that can be made in the yards or wool-shed will be employed wherever possible. It is expected, however, that it will become desirable in practical breeding sometimes to sort out the individual fibres of a specimen against a black background. Such work might be the employment of professional sorters of wool on the minute scale, but it would be perfectly possible for the breeder to carry it out himself.

Two kinds of hairiness are recognized: kemp and non-kemp. These two kinds are not wholly independent, but it is necessary to select against them separately.

Large birthcoat kemps, or halo-hairs, may be recognized at a glance at birth or at docking-time.

From the practical point of view it is only when halo-hairs are present in a portion of the fleece that kemp is of consequence in that region later.

Halo-hairs on falling out are often succeeded in the same roots by secondary kemps and by very coarse hairy fibres of persistent growth.

A series of breeding experiments has shown that the abundance of halo-hairs is strongly inherited. Selection for complete freedom from halo-hairs on the back has been largely effective.

It is suggested that selection against halo-hairs should be as keen as is practicable, with attention paid especially to the back and britch.

If the abundance of halo-hairs has not been noted before they fall out, a lookout may be kept, when examining specimens in benzol at six months or later, for hairy fibres not reaching the tip of the staple that may be succeeding halo-hairs in the same roots.

In lambs growing normally non-kemp hairiness makes its appearance, as the coat continues its growth after birth, in the very early days of the animal's life. Lambs free at three weeks may be accepted as entirely desirable on this count.

When non-kemp hairiness is at all well sustained down the staple in the lamb's coat, it is indicated by preliminary studies that the abundance of hairy fibres is much the same in each of the first four fleeces.

The statement by breeders that the third fleece may be badly hairy after the animal has been deemed acceptable on the first two fleeces is probably to be explained by greater coarseness of the non-kemp hairy fibres of the third fleece, with the state of affairs in the earlier fleeces open to detection in benzol even though it be not recognized by eye.

When non-kemp hairiness on the back and side in the first year's fleece is not sustained for more than about two months, then in the same part of the next fleece there may be less hairiness, or none at all, and then the third fleece also has been free.

Towards the animals just described one will be lenient in flocks in which it is not feasible to adopt an exacting standard.

When the standard is more rigid one would prefer an animal, especially a ram, to be free from hairiness not only in later fleeces, but in that of the first year.

Experiments of a rough kind point to the great importance of inherited factors in determining non-kemp hairiness. In these experiments some lambs were more hairy than either parent. These findings are in line with the experience of breeders.

Non-kemp hairiness is affected by physical conditions and by nutrition. In the work described greater hairiness has tended to accompany vigorous growth of the fleece.

Lambs thriving badly have been less hairy than they would have been had they made better progress.

It is suggested that it is best to judge the hairiness of an animal on wool grown when conditions are most favourable to the production of medulla, and that, in sheep that have been shorn, is usually just after shearing.

The balance between slight hairiness and freedom from medulla is easily tipped by non-genetic factors. On this and other grounds non-hairy wools are believed to differ in the margin by which they escape hairiness. For preventing hairiness in his offspring one non-hairy ram may be expected to be better than another. To discover the means of judging non-hairy wools from this point of view is regarded as a major problem.

Without discussing the matter exhaustively, enough has been said, following earlier articles, to emphasize the significance of features of the coat in the early days and months of life. The importance of detailed knowledge about the coat of the young lamb is the chief point to which it is desired to give prominence.

DAIRY-HERD TESTING IN NEW ZEALAND.

REVIEW OF THE 1933-34 SEASON.

W. M. SINGLETON, Director of the Dairy Division, Department of Agriculture, Wellington.

It is just twenty-five years since the introduction of systematic herd-testing to New Zealand, and it is interesting to review the progress of the movement in that brief quarter of a century. In August, 1909, New Zealand's first cow-testing association commenced operations. This was in the Wairarapa district. The work was organized and carried out by the Dairy Division in co-operation with the Dalefield Dairy Co. and a number of its suppliers, 815 cows being tested. During the following season the testing was continued at Dalefield and extended to Cambridge, Stratford, and Kaupokonui. The third season, 1911-12, saw two further associations in operation, these being at Whangarei in the North and Stirling in the South. Woodville, Kairanga, and Tai Tapu came in in 1912-13, and by 1918-19 the dairying districts of the Dominion were fairly well catered for, as, in addition to the localities already named, there were cow-testing associations at Cheltenham, Konini, Riverbank, Te Rehunga, Ngaire, and Hawera. These various organizations were conducted by the Dairy Division and were regarded as "illustration" associations. It was hoped that they would illustrate to dairy-farmers the method of conducting the work and the benefits to be obtained from the information relating to yield provided by the returns with which the member was supplied, both monthly and at the end of the season. Although now almost entirely superseded by the "Group" system, the "Association" system rendered a great service to dairy-farmers, and on account of its simplicity and low cost succeeded in establishing herd-testing where a more elaborate and expensive method might easily have failed.

THE GROUP TEST.

By 1914-15 the number of cows tested during the season had reached the 25,000 mark. Thereafter for a year or two the numbers declined, due partly to shortage of labour on the farms and partly to concentration on the tremendously increased output of dairy-produce, both factors being the direct result of the Great War. There were, however, other important influences, the principal one being the rapidly increasing usage of the milking-machine. The adoption of mechanical milking complicated the taking of milk weights and samples, and it became apparent that future progress in herd-testing depended upon taking the work out of the dairy-farmers' hands. The years 1920 to 1922 witnessed a revival of interest in herd-testing, and the number of tested cows rose from 17,000 in 1918-19 to 45,500 in 1921-22. Although the Government was still conducting a large number of associations, its policy was to withdraw as rapidly as practicable in favour of private enterprise.

The start of a revival came with the introduction of the Group-system in the Waikato in 1922. The development of the system is obvious from the fact that last season nearly 300,000 cows were tested systematically in this Dominion, and that almost 92 per cent. of these

were tested by the Group method. The Group herd-testing operations in New Zealand have been developed into a thoroughly organized movement, and practically every Group organization is now registered under the Incorporated Societies Act, while the various groups are in turn federated with the Dominion Group Herd-testing Federation (Incorporated). This organization was established primarily to standardize or assist in standardizing Group herd-testing methods throughout New Zealand, and also to extend the work. Membership of the federation is confined to Group herd-testing associations registered under the Incorporated Societies Act. The expenses of the federation are met by a levy on all cows tested by federated groups. This organization employs Mr. C. M. Hume as Federation Supervisor of Herd-testing, and his principal duties are to supervise the Group herd-testing movement, with a view to standardizing practice, increasing efficiency, effecting economy where possible, and, where possible, assisting to extend the membership. His salary and expenses are defrayed partly by the Government and partly by the federation.

GOVERNMENT SUBSIDY TO HERD-TESTING.

Since 1927 the Government has given an annual subsidy to testing dairy-herd owners and by way of assistance in establishing new organizations and extending the movement. The largest amount granted in any one year was £10,500, the smallest—that for last season's testing—£5,000. In 1932 the New Zealand Dairy-produce Control Board also gave a grant of £6,000 to herd-testing.

It will be apparent that the Government has rendered considerable assistance to herd-testing, both by way of education and fostering the work as well as by financial aid, and it is safe to say that herd-testing would not have been so firmly entrenched to-day without that Government financial aid and sympathetic support.

NEW ZEALAND HERD-TESTING CENTRAL EXECUTIVE.

In 1929 the New Zealand Herd-testing Central Executive was formed, principally for the purpose of allocating Government subsidies to herd-testing and supervising the movement generally. This body comprises nine members and a secretary. The representation is as follows: The Dominion Group Herd-testing Federation, four members, one of whom acts as Chairman; the New Zealand Dairy-produce Control Board, one member; the Dairy Research Institute, one member; the New Zealand Dairy Breeds Federation, one member; the Department of Agriculture, two members. The secretary is an officer of the Dairy Division, Department of Agriculture.

DEVELOPMENT OF HERD-TESTING.

Prior to the foundation of the Dominion Group Herd-testing Federation, herd-testing was not organized, inasmuch as there was no co-ordination between the various associations. With the introduction of the Group system commenced the decline of the Association system and the really rapid progress of the movement.

Table 1 provides a general summary of the herd-testing movement since its inception from the point of view of average production and number of cows tested. For purposes of comparison, figures have

been included regarding New Zealand's total dairy-cow population and the estimated average butterfat-production for all cows in milk and dry.

Table 1.

Season.	Cows in Milk and Dry.		Number of Cows in Milk.	Tested Cows.		Percentage of Tested Cows to Cows in Milk.
	Number.	Average Yield of Fat.		Number.	Average Yield of Fat.	
		lb.			lb.	
1909-10 ..	583,163*	148.45	..	815	..	..
1910-11 ..	633,733	139.46	..	4,317	..	..
1911-12 ..	655,503*	140.10	..	13,440	..	..
1912-13 ..	678,021*	150.78	..	25,000	..	..
1913-14 ..	701,312*	156.52	..	25,000	..	..
1914-15 ..	725,403*	154.07	..	24,000	..	..
1915-16 ..	750,323	160.52	..	24,105	..	..
1916-17 ..	777,439	163.96	684,032	14,343	..	2.0
1917-18 ..	793,215	152.23	710,561	26,768	..	3.7
1918-19 ..	826,135	150.64	732,253	17,000	..	2.3
1919-20 ..	893,454	152.04	782,757	25,134	230.25†	3.2
1920-21 ..	1,004,666	154.25	890,220	35,757	210.92†	4.0
1921-22 ..	1,137,055	174.97	1,015,325	45,564	232.99†	4.5
1922-23 ..	1,248,643	180.62	1,124,671	84,825	233.82	7.5
1923-24 ..	1,312,589	174.10	1,184,977	151,214	212.75	12.7
1924-25 ..	1,323,432	182.09	1,195,567	196,850	223.54	16.4
1925-26 ..	1,303,856	179.40	1,181,441	169,776	220.51	14.4
1926-27 ..	1,303,225	198.50	1,181,545	170,150	240.48	14.4
1927-28 ..	1,352,398	195.38	1,242,729	224,130	224.68	18.0
1928-29 ..	1,371,063	210.84	1,291,204	259,594	240.50	20.1
1929-30 ..	1,440,321	218.05	1,388,872	283,731	253.61	20.4
1930-31 ..	1,601,633	201.04	1,499,532	271,404	241.05	18.0
1931-32 ..	1,702,070	199.65	1,582,664	259,857	236.87	16.4
1932-33 ..	1,845,972	215.10	1,723,913	286,054	255.57	16.6
1933-34 ..	1,932,511	220.80	1,816,402	297,647	262.44	16.4

* Geometric mean.

† Associations conducted by the Dairy Division.

The figures in Table 1 help us to realize the progress which has been made not only in cow-testing, but in dairy-production as a whole. In 1909-10 our dairy-cow population was 583,163, whereas in 1933-34 it was 1,932,531, while in total butterfat-production the figures were 86,572,741 lb. and 426,699,242 lb. respectively, an increase of nearly 500 per cent. Another interesting feature is the rapidly decreasing number of dry cows in proportion to total cows. From another point of view the table indicates the progress which has been made *through* herd-testing as well as *in* herd-testing, and it is safe to say that our present position regarding average butterfat-production and consequently total butterfat-production would not have been nearly so favourable without the good influence of herd-testing. The position regarding percentage of cows tested is not quite so favourable as that regarding number of cows tested, but in view of the severity of the depression we should be satisfied with having avoided a further decrease from the peak year of 1929-30.

Separate figures for average production under Group and Association Own-sample systems are available only for ten years back. These are given in Table 2, and afford an interesting comparison, the decline of the original Association system being obvious. A gratifying position is the marked increase in average lactation period, which, it will be noted, is much more apparent in the case of the Group system, methodical practice having exerted a favourable influence.

Table 2.

Season.	Group Herd-testing.			Association's Own Sample.		
	Cows.	Average Fat.	Average Days.	Cows.	Average Fat.	Average Days.
		lb.			lb.	
1924-25 ..	82,961	222.54	235	68,914	224.75	221
1925-26 ..	97,575	223.06	236	48,823	215.40	217
1926-27 ..	108,150	243.88	241	46,878	232.64	220
1927-28 ..	158,734	228.46	237	47,589	212.07	204
1928-29 ..	206,089	241.69	246	39,722	234.33	222
1929-30 ..	236,941	254.32	251	35,613	248.88	223
1930-31 ..	234,799	241.50	250	25,670	236.90	225
1931-32 ..	229,606	238.11	256	21,835	223.79	229
1932-33 ..	253,016	256.86	259	23,163	241.46	232
1933-34 ..	266,481	264.10	257	20,408	240.79	230

As a result of our herd-testing movement, combined with the Certificate-of-Record and Government Official Herd-testing, we are steadily accumulating a large mass of information regarding the productive ability of our dairy cows. Such information is invaluable as a basis for herd-building, herd-management, and improved dairy-farming methods.

RESULTS FOR 1933-34.

During the past season a peak was reached for both number of cows tested and average production of tested cows. Some 297,647 cows were tested, representing an increase of 11,593 cows, or 4.05 per cent., over the 1932-33 total of 286,054. The average butterfat-production per tested cow was 262.44 lb., an increase of 6.87 lb. fat over the previous season's average of 255.57 lb. An item worthy of special mention relates to the achievement of an average of over 300 lb. fat per cow by the South Taranaki Herd-testing Association. Their returns for last season were 309.89 lb. fat per cow in 282 days for 8,087 cows. This was the first occasion on which an organization has succeeded in reaching the objective set by the Dominion Group Herd-testing Federation some years ago.

Table 3 provides statistics relating to dairy cows in milk and dry, and covering the past ten years.

Table 3.—Dairy Cows in Milk and Dry as at 31st January of each Year.

Season,	Total Cows.	Cows in Milk.	Dry Cows.	Percentage of Dry Cows to Total.
1924-25 ..	1,323,432	1,195,567	127,865	9.7
1925-26 ..	1,303,856	1,181,441	122,415	9.4
1926-27 ..	1,303,225	1,181,545	121,680	9.3
1927-28 ..	1,352,398	1,242,729	109,669	8.1
1928-29 ..	1,371,063	1,291,204	79,859	5.8
1929-30 ..	1,441,410	1,389,541	51,869	3.6
1930-31 ..	1,601,633	1,499,532	102,101	6.4
1931-32 ..	1,702,070	1,582,664	119,406	7.0
1932-33 ..	1,845,972	1,723,913	122,059	6.6
1933-34 ..	1,932,511	1,816,402	116,109	6.0

A numerical classification of tested cows according to land district is given in Table 4. It will be noted that the tested cows represent 16.4 per cent. of our total cows in milk, and that, while the total number of tested cows continues to increase, we are barely holding our own from the point of view of percentage tested.

Table 4.—Numbers of Cows tested Twice or more, and Percentages of Total Cows in Milk, classified according to Land Districts.

Land District.	1929-30.		1930-31.		1931-32.		1932-33.		1933-34.	
	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.
North Auckland	58,113	24.5	55,283	20.9	56,001	19.6	59,408	18.8	55,801	16.4
Auckland ..	109,811	26.8	102,534	22.6	99,806	20.6	111,517	21.1	120,082	21.3
Gisborne ..	12,329	33.4	10,418	25.0	9,145	20.4	10,634	19.9	12,460	21.8
Hawke's Bay	8,505	17.0	8,742	16.7	4,933	9.2	5,910	10.3	5,581	8.9
Taranaki ..	31,693	15.1	32,519	14.7	31,179	13.8	32,302	13.6	38,878	15.7
Wellington	42,224	21.1	35,875	16.7	30,569	13.6	34,992	14.6	38,290	15.2
North Island	262,675	23.0	245,371	19.7	231,723	17.6	254,763	17.8	271,992	17.8
Nelson ..	2,128	8.0	5,732	20.9	6,637	23.7	7,430	23.8	4,445	13.6
Marlborough	3,628	23.7	3,064	19.2	2,647	16.2	2,334	13.6	2,067	11.9
Westland ..	..	..	2,380	18.8	5,030	39.6	2,844	20.4	2,801	19.2
Canterbury	2,816	3.8	3,244	4.3	2,344	3.1	4,359	5.4	4,957	6.0
Otago ..	2,975	5.7	3,775	7.0	4,480	7.9	4,800	7.9	3,752	6.1
Southland	9,509	13.7	7,838	10.9	6,996	9.4	9,524	11.7	7,633	9.3
South Island	21,056	8.5	26,033	10.2	28,134	10.6	31,291	11.0	25,655	8.8
Dominion	283,731	20.4	271,404	18.0	259,857	16.4	286,054	16.6	297,647	16.4

NOTE.—"Total Cows in Milk" is at 31st January in each year.

Table 5 is a summary indicating the number and size of the various organizations. An "organization" denotes an individual unit—that is to say, a Group herd-testing association operating ten groups would be included as ten, not one.

Table 5.—Number of Cows, Herds, and Organizations represented in Season's Summaries received. (Basis: All Cows in Milk 100 Days or over.)

	1931-32.	1932-33.	1933-34.
<i>Group Testing.</i>			
Number of groups	197	200	213
Number of herds	4,772	5,090	5,120
Number of cows	229,606	253,016	266,481
Average number of herds per group	24	25	24
Average number of cows per herd	48	50	52
Average number of cows per group	1,166	1,265	1,251
<i>Association Testing.</i>			
Number of associations	81	78	73
Number of herds	1,213	1,242	1,105
Number of cows	21,835	23,163	20,408
Average number of herds per association	15	16	15
Average number of cows per herd	18	19	18
Average number of cows per association	270	297	280

Table 6 is a general production summary. Figures for 6,225 herds were surveyed for the compilation of this table, of which 5,120 were tested under the Group system and the remaining 1,105 under the Association Own-sample test. The corresponding figures for 1932-33 were 6,332 herds—5,090 Group and 1,242 Association.

Table 6.—Grand Summary of all Herd-testing Results on the Basis of all Cows in Milk 100 Days or over received for the Last Two Seasons.

	1932-33.			1933-34.		
	Number of Cows.	Days in Milk.	Butterfat-production.	Number of Cows.	Days in Milk.	Butterfat-production.
			lb.			lb.
Average for all cows ..	276,179	257	255.57	286,889	255	262.44
Average for all Group cows ..	253,016	259	256.86	266,481	257	264.10
Average for all Association cows ..	23,163	232	241.46	20,408	230	240.79
Highest Group average ..	403	260	318.61	294	282	334.25
Lowest Group average ..	688	249	204.23	1,022	225	194.00
Highest Association average ..	43	262	335.70	108	264	337.90
Lowest Association average ..	48	181	152.74	106	208	178.91
Highest Group herd ..	6	296	465.67	15	305	551.00
Lowest Group herd ..	3	128	71.33	24	192	88.00
Highest Association herd ..	31	315	488.15	4	312	435.07
Lowest Association herd ..	3	113	57.32	22	126	92.00
Highest Group cow ..	..	..	763.49	..	261	879.00
Highest Association cow ..	..	245	645.00	..	294	775.00
Average daily production of butterfat for all Group cows ..	..	..	0.99	..	..	1.03
Average daily production of butterfat for all Association cows ..	..	..	1.01	..	..	1.05

In Table 7 average butterfat-production is classified according to and districts.

Table 7.—Average Production, according to Land Districts, of all Cows under Herd-test for which Seasons' Summaries were obtained.
(Basis : 100 Days or over.)

Land District.	1930-31.			1931-32.			1932-33.			1933-34.		
	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.
North Auckland ..	53,158	243	lb. 218.16	54,101	253	lb. 229.56	57,771	255	lb. 245.53	54,007	250	lb. 241.11
Auckland ..	99,942	253	243.95	97,218	260	233.61	108,504	264	254.67	116,769	260	262.09
Gisborne ..	9,899	235	225.13	8,853	250	242.29	10,265	251	254.73	11,967	251	247.50
Hawke's Bay ..	8,324	227	219.28	4,808	253	246.71	5,595	255	263.61	5,389	253	258.75
Taranaki ..	31,633	259	268.40	29,960	257	256.41	31,686	265	276.19	37,790	264	286.32
Wellington ..	34,152	248	252.29	29,215	244	226.03	32,012	253	255.61	36,491	255	275.64
North Island ..	236,208	249	240.97	224,155	256	235.32	245,833	260	255.62	262,413	257	262.41
Nelson ..	5,464	229	244.36	6,447	236	250.16	7,215	239	269.27	4,322	245	272.36
Marlborough ..	2,913	237	247.20	2,567	239	247.67	2,151	239	249.70	1,944	228	232.63
Westland ..	2,321	229	234.54	4,902	232	241.59	2,816	236	260.89	2,773	241	273.17
Canterbury ..	2,627	212	220.57	2,155	219	226.67	4,129	223	233.38	4,449	236	255.26
Otago ..	3,535	228	237.94	4,319	236	252.03	4,685	238	249.02	3,568	229	264.85
Southland ..	7,401	231	249.47	6,896	237	261.26	9,350	235	256.32	7,420	227	264.66
South Island ..	24,261	229	241.81	27,286	234	249.63	30,346	235	255.11	24,476	234	262.76
Dominion ..	260,469	247	241.05	251,441	253	236.87	276,179	257	255.57	286,889	255	262.44

GOVERNMENT SUBSIDY.

The New Zealand Herd-testing Central Executive has held two meetings during the season. The amount of Government subsidy available for the current financial year—that is to say, applying to the past season's testing—is £5,000. After special grants for new groups, &c., are allowed for, this enables a payment to testing dairy-herd owners of 2½d. per cow for Group testing and 1d. per cow for the Association Own-sample system.

APPRECIATION.

We desire to again express thanks to officers in charge of herd-testing organizations for providing the particulars required for the compilation of this survey. The data submitted last season were so complete and accurate that every summary could be used.

SEED CERTIFICATION.

SUMMARY OF OPERATIONS FOR SEASON 1933-34.

J. H. CLARIDGE, Assistant in Agronomy, Plant Research Station, Palmerston North.

THE seventh season's activities in connection with seed certification undertaken by the Fields Division of the Department of Agriculture is dealt with in the following summary of operations for the season 1933-34. There has been a reduction of 24 per cent. in the number of areas of the various crops inspected, the total for 1933-34 being 1,995. This reduction is confined to areas of perennial rye-grass.

The certification scheme has been extended during the season to include swede and turnip seeds, while several alterations have been made to the procedure in regard to certain other crops. Particulars regarding each crop are discussed under the various headings.

PERENNIAL RYE-GRASS.

An important change in the classification of certified rye-grass seed has been made in the season now closing. In the past, two subclasses have been recognized within the "Permanent Pasture" class—namely, "Permanent Pasture (First Harvest)" and "Permanent Pasture eligible for reclassification as Mother Seed." These two subclasses have now been deleted, and all seed thus classified previously now comes into the ordinary "Permanent Pasture" class.

This alteration has brought about two main results: Firstly, the simplification of the classes of certified perennial rye-grass seed, and, secondly, a reduction in the amount of Mother seed by the deletion of potential Mother seed areas.

A 43 per cent. reduction in the acreage inspected has been recorded for the 1933-34 season (from 23,000 acres to 13,000 acres). This reduction, coupled with a reduction by 16 per cent. in the average yield, has resulted in the certification of only 119,000 bushels of machine-dressed seed, as compared with 246,000 bushels during 1932-33.

The general run of yields in Canterbury and parts of Otago was very disappointing. In North Canterbury, for example, the average yield was less than half that of the previous season.

There has been no difficulty in the great majority of cases in obtaining the required standard of purity for certified rye-grass seed. The germination of most of the North Island lines has been good. In North Otago and South Canterbury germination figures have been rather below the average, but in Otago and Southland the samples tested have returned improved percentages as compared with those of previous seasons.

COCKSFOOT.

The 1933-34 season has been a very unsatisfactory one from the point of view of the cocksfoot-seed grower. Whereas in 1932-33 some 600,000 lb. of machine-dressed seed was obtained, at an average yield of 160 lb. per acre, in the season just ended the average yield fell to 48 lb. per acre, giving a total certified production of 200,000 lb. Eighty per cent. of this seed was produced on the Akaroa Peninsula, under the immediate supervision of the Akaroa Cocksfoot Seed Growers' Association.

Only 3,000 lb. of the total seed failed to qualify in the "Mother Seed" class, the determining factor being one of age.

WHITE CLOVER.

There has been a considerable increase (from 3,000 lb. to 7,000 lb.) in the amount of Mother white clover seed produced in the past season. In the case of Permanent Pasture seed, on the other hand, the supply has fallen from 31,000 lb. to 13,500 lb.

A number of areas which have been sown with certified Mother seed are now being offered for certification. Two thousand five hundred pounds of the seed included in the Permanent Pasture class was harvested from such areas.

In addition to the above, there are some areas, particularly in parts of North Canterbury, which it is considered are reasonably certain to be of Mother seed standard, despite the fact that no sample trial report on seed harvested from these areas has yet been obtained. The produce of eleven such areas has been held under official supervision until such time as a sample trial report is available. It may then be found possible to certify to part or all of this seed.

BROWN-TOP.

The number of areas of brown-top under certification has shown an increase from 85 in 1932-33 to 103 in 1933-34. Two of the areas inspected, both in South Canterbury, were rejected on account of the presence of red-top, but all other areas were accepted.

One hundred and nineteen thousand pounds of machine-dressed seed has been obtained from these areas—a reduction of 16,000 lb. on the previous season's production. Over 50 per cent. of the seed certified was produced in the Otago District.

RED CLOVER.

The harvesting of certified Montgomery red clover seed has been more firmly established during the 1933-34 season. Thirteen areas, totalling 165 acres, have been accepted, compared with 4 areas (71 acres) in 1932-33. Three of these areas have been accepted as Mother seed areas, from which 4,443 lb. of machine-dressed seed has been sealed and tagged, while 12,820 lb. of machine-dressed seed has been obtained from the Permanent Pasture areas harvested. The total production amounts to 17,263 lb., as against 3,763 lb. for the season 1932-33. The average yield per acre is equal to 103 lb.

WHEAT.

While the acreage of wheat entered for certification in the 1933-34 season shows an increase of almost 1,000 acres over that for the previous season, the acreage passed (1,100 acres) is 400 acres less. A few crops were entered this season from the North Island, but the majority of the crops were grown in Canterbury. There has been an increase of 300 sacks branded in the paddock this season, 6,700 sacks having been so treated. The quantity of seed machine-dressed has fallen from 7,000 to 6,000 bushels, however.

POTATOES.

The number of potato crops inspected in the 1933-34 season constituted a record, when 429 areas were entered for field inspection, exceeding by 66 crops the previous highest number (in 1929-30). The number of crops passing inspection was also considerably higher than in any previous season.

This season, for the first time, no crops were rejected on account of the presence of foreign varieties. The position in regard to the purity of crops in certification may therefore be regarded as entirely satisfactory. The amount of rejection on account of high virus infection or low cropping power is 23.8 per cent., a considerable improvement on the figures of any previous season, despite the fact that a gradually higher standard is being adopted each year in this respect. Aucklander Short Top and Dakota are again the most popular varieties, though the number of Arran Chief crops has considerably increased. Arran Banner has risen to fourth place in regard to the number of lines entered of any one variety.

An alteration in the classification of those crops provisionally certified has been adopted in connection with this season's crops. In addition to the classification into groups, which was introduced for the season 1932-33, crops are now classified also as either "Mother" or "Commercial." This classification depends upon whether it is considered that the crops are worthy of further multiplication for the production of certified seed, or whether they are of a slightly lower standard, but still quite suitable for the production of crops of commercial potatoes.

The quantity of seed potatoes that has passed the tuber inspection to the end of October amounts to 1,142 tons of Mother seed and 590 tons of Commercial seed, an increase of 800 tons on the quantity similarly treated in the 1932-33 season. The number of entries in the qualification trials totalled 149, a slight increase over the number in the previous season. A rather higher percentage was classified in the highest-quality group, there also being a fewer number of badly mixed lines.

TURNIP AND SWEDE SEED.

The certification of turnip and swede seed was inaugurated in the 1933-34 season, when 15 areas (133 acres), comprising eight varieties, were entered, the majority being entered by one grower. One area of 5 acres was rejected on account of varietal impurity, the others all reaching the necessary standard for certification.

Over 22,000 lb. of seed has been finally sealed and tagged. The yield of seed from the areas entered has been low, averaging only 177 lb. per acre.

ALL CROPS IN CERTIFICATION.

The following table summarizes the acreages of each crop inspected since the inauguration of certification in 1927:—

Seed.	Chief Consideration upon which Certification is based.	Acres inspected each Season.						
		1927-28.	1928-29.	1929-30.	1930-31.	1931-32.	1932-33.	1933-34.
Potatoes ..	Varietal purity, cropping-power, and freedom from virus diseases	821	909	1,200	1,334	1,146	1,154	1,322
Wheat ..	Varietal purity and freedom from loose and stinking smuts	473	1,184	2,277	3,289	1,063*	1,873	2,937
White clover ..	Ages of pasture, 1928-31. Type of clover, 1931-34	..	325	664	311	31†	100†	538
Perennial rye-grass	Genuine perennial type conforming to certain standards of purity	..	..	3,028	6,539	9,709	22,917	13,236
Brown-top ..	Freedom from red-top (<i>Agrostis palustris</i>)	..	..	22,000	24,901	18,297	14,860	17,370
Cocksfoot ..	Type as exemplified in the produce of Banks Peninsula	..	..	..	..	4,226	5,097	5,485
Montgomery red clover	Type conforming to that of English grown Montgomery red clover	..	..	..	..	9	71	183
Turnips and swedes	Varietal purity and freedom from disease	..	..	..	..	..	..	133
Totals ..	..	1,294	2,418	29,169	36,374	34,481	46,072	41,204

* An alteration in the regulations was the cause of this reduction.

† Reduced area due to alteration of standard from one of age to one of type. Acreage given does not include white clover, which was separated from rye-grass during machine-dressing.

NOTE.—Persons or firms interested in the complete tabulated results may obtain copies of these upon application.

HARVESTING OF BARLEY AND WHEAT.

OBSERVATIONS ON THE BINDER, WINDROW, AND DIRECT HEADING METHODS.

C. H. HEWLETT and J. H. HEWLETT, Canterbury (N.Z.) Seed Co., Ltd., and H. E. WEST, Wheat Research Institute, Christchurch, N.Z.

DURING the harvest of 1933 comparative tests of harvesting barley and wheat by the binder, windrow, and direct heading methods were conducted on the Canterbury (N.Z.) Seed Co.'s farm at Leeston by the writers of this article.

In order to ascertain the effect of the different methods of harvesting upon the quality of the grain, 101 moisture tests of the grain in the field at various stages were taken.

Further, 117 analyses of the barleys and wheats after threshing were made. The barleys were malted and analyses made of the malt. The wheats were made into bread and the baking scores recorded.

Satisfactory results regarding quality were obtained from barleys and wheats harvested by the binder and windrow methods, but the

quality of the direct-headed grain was not equal to that of the wheats harvested by the binder or windrowed. The windrowed grain dried faster than the stook-threshed.

It would be preferable if four or five years' results were available, but they are not, and, without entering into detail, our conclusions based upon the one year's observations are as follow:—

Binder Method.—Satisfactory for all grain.

Windrow Method.—Satisfactory for all grain. Cheaper than binder method and very little more expensive than direct heading.

Direct-heading Method.—Unsatisfactory for barley. Satisfactory for solid-straw Tuscan wheat only, provided suitable weather conditions prevail.

TURNIPS OR BLUE LUPINS AND ITALIAN RYE-GRASS FOR WINTER SHEEP-FEED.

SOME RECORDS OF THEIR CARRYING-CAPACITY ON MEDIUM TO LIGHT LAND IN CANTERBURY.

A. H. FLAY, Canterbury Agricultural College, Lincoln.

OF recent years the successful growing of turnips on medium and light land for winter feed has become more uncertain. In the autumn of 1933 the diamond-back moth ruined most crops either partially or wholly. This winter, 1934, turnips and swedes were, in some instances, badly affected with dry-rot, and up to 20 per cent. of some crops have been rendered useless. The value of a good turnip crop, especially along the foothills where high yields can be secured, is not questioned, but it is interesting to note that simultaneously with the difficulty and uncertainty of turnip-growing more and more attention is being given to the use of lupins. This development is most marked on medium and light land. The different uses to which blue lupins are being put, the time of the year at which they may be eaten to the best advantage, and the best stage of growth for sheep grazing for various purposes have not, as yet, been clearly defined. Their economic uses under various systems of farm-management await further investigation. However, when sown with Italian rye-grass their use as winter feed has been demonstrated on medium to light land by an Ashburton farmer. The experiences of this farmer and his records of the winter carrying-capacity of turnips and of blue lupins with Italian rye-grass form the basis of this article.

In the season 1931-32 this farmer "headed" a crop of lupins on 28th December, 1931. This was the first time he had grown them as a cash crop and a "nor'-west" wind was responsible for a loss of seed. Some of the seed which had fallen on the ground was eaten by the lambs and sheep, the remainder was ploughed in during early February. The original intention was to follow the lupins with wheat, instead of which the wheat was sown in the field fallowed for turnips, and 20 lb. of Italian rye-grass seed per acre was drilled in over the ploughed-in lupin-seed. This was done with the object of securing the maximum bulk of winter green feed to replace turnips.

METHOD OF GRAZING.

The sheep were kept in a holding paddock and put on to "breaks" of turnips or lupins with Italian rye-grass for several hours daily. When there was ample or a probable surplus of winter feed, or ewes were being fattened on turnip-tops, full-time grazing was allowed. In the spring full-time grazing of the Italian rye-grass was also practised. Supplementary feeds, hay, chaff, or chaffed straw were used in sufficient quantities to enable the succulent feed to be rationed throughout the winter period.

In the winter of 1932 the largest proportion of the lupins were in the "full-leaf" stage, just before flowering, which actually took place on some plants in the last break to be fed in September. The following winter (1933) the lupins were not as far advanced in growth as in the



FIG. 1. BLUE LUPINS AND ITALIAN RYE-GRASS BEING GRAZED AS WINTER FEED ON FARM OF MR. W. HAMMOND, WINCHMORE, ASHBURTON.

[Photo. by A. H. Flay.]

previous one and even at the time of feeding the last break the flowering stage had not been reached. However, it would have required only a few more weeks, and many plants would have flowered in the latter part of September or early October. During the first winter the sheep distinctly preferred the Italian rye-grass at the beginning of grazing. As the winter advanced this preference was less and less marked until it ceased to be noticeable. In the second winter (1933) those sheep used to lupins ate them readily enough, but sheep new to such feed repeated the performance of the main mob in the previous year. Toward the end of both winters all sheep ate the lupins readily, even on new breaks.

In grazing the lupins the sheep nipped the stalk at a height of 6 in. to 12 in. or more from the ground. Of the fallen part the stalk and leaves were eaten to about 4 in. to 6 in. of the tip. This last 4 in. to

6 in. was rarely eaten, usually being left on the ground. It appears to be distinctly unpalatable. The green leafage on the remaining standing stalk was eaten off and the stem, if young and succulent, was eaten fairly close to the ground. After being grazed down the lupins did not grow any further.

RECORDS AND CARRYING-CAPACITY OF TURNIPS.

The last crop of turnips grown on this farm was grazed in the winter of 1931. Fortunately, complete records were kept of three crops which were consumed in the winters of 1929, 1930, and 1931. For this locality the crops grown were good. It will be recalled that during these years the seasons for turnip production were more favourable than those of more recent times.

As calculated from the records of stock grazed (see appendix) the carrying-capacities for the winters of 1929, 1930, and 1931 are given in Table 1.

Table 1.—Records and Carrying-capacity of Turnips.

Month.	Monthly Carrying-capacity per Acre as Dry Sheep.		
	1929.	1930.	1931.
April	..	0.4	..
May	..	2.3	1.9
June	..	6.4	0.7
July	10.2	11.2	11.2
August	9.8	10.0	14.8
September	6.1	..	4.4
October	..	..	1.0
Average for three-month period	8.7	10.1	11.3

RECORDS AND CARRYING-CAPACITY OF BLUE LUPINS WITH ITALIAN RYE-GRASS.

As calculated from the records of the sheep grazed (see appendix) the carrying-capacities of blue lupins and Italian rye-grass for the winters of 1932 and 1933 are given in Table 2.

Table 2.—Records and Carrying-capacity of Lupins and Italian Rye-grass.

Month.	Monthly Carrying-capacity per Acre as Dry Sheep.	
	1932.	1933.
June	3.6	0.1
July	9.6	8.9
August	9.8	11.6
September	4.9	4.0
Average for three-month period	9.3	8.2

The lupins with Italian rye-grass proved very satisfactory as a winter feed, lambing, spring, and early summer feed, besides yielding

a profitable crop of grass-seed from a portion of the area. The favourable results of the first trial led the farmer to grow another crop of lupins and Italian rye-grass to replace turnips for the winter of 1933. The lupins and Italian rye-grass were drilled in during February, 1933, on a well-prepared and fallowed seed-bed, and, despite the record dry autumn of 1933, they grew satisfactorily. By mid-June the lupins had made about 1 ft. less growth than in the previous season, when they averaged from $3\frac{1}{2}$ ft. to 4 ft. in height (see photos).

SPRING GRAZING FROM ITALIAN RYE-GRASS.

After the winter grazing of each crop of lupins and Italian rye-grass the rye-grass came away in the spring and was used for lambing green feed, and later for grazing ewes and lambs. Each year a



FIG. 2. BLUE LUPINS AND ITALIAN RYE-GRASS.

[Photo. by A. H. Flay.]

portion of the field was closed for grass-seed. The grazing obtained from this grass throughout the spring for the two seasons is given in Tables 3 and 4.

Table 3.—Spring of 1932.

Year.	Month.	Carrying-capacity per Month as	
		Dry Sheep per Acre.	Ewes and their Lambs Per Acre.
1932 ..	September ..	0.71	..
1932 ..	October ..	2.16	1.80
1932 ..	November ..	3.20	2.42
1932 ..	December ..	4.45	3.01
1933 ..	January ..	2.26	..
1933 ..	February ..	1.32	..

The last break of lupins was finished on 10th September, and at that time 11 acres of the earlier grazed portions were closed for grass-seed. It will be seen, therefore, that the grazing of the Italian rye-grass as lambing-feed during September, although calculated as from the whole field of 26 acres, is in reality from perhaps not more than half of this area. Also the grazing of this area was not commenced until the 12th September. The last break was finished on 10th September and here the Italian rye-grass provided little feed until October. The hard winter grazing has a weakening effect on the plants and a certain rest period is necessary for recovery. These notes explain the low carrying-capacity of the Italian rye-grass during the month of September.

From the records of stock movements the grazing from the Italian rye-grass in the spring of 1933 is calculated as follows:—

Table 4.—Spring of 1933.

Year.	Month.	Carrying-capacity per Month as	
		Dry Sheep per Acre.	Ewes and their Lambs Per Acre.
1933	September	1.12	1.00
1933	October	2.68	2.23
1933	November	3.15	2.38
1933	December	2.84	1.91
1934	January	2.00	..
1934	February	0.65	..

Other than different dates for the finish of the winter grazing of the lupins and Italian rye-grass, and for the commencement of grazing the Italian rye-grass as lambing-feed, the same remarks as for season 1932 apply to the September figure. In the two seasons the Italian rye-grass, which was dying out, was ploughed in the latter part of February or early March for wheat, and on both occasions good crops were grown.

SUMMARY OF WINTER CARRYING-CAPACITIES.

The winter carrying-capacities of turnips and of lupins with Italian rye-grass are summarized in Table 5.

Table 5.—Carrying-capacity per Acre for a Three-month Period in Winter as Dry Sheep or In-lamb Ewes.

Year.	Turnips.	Lupins with Italian Rye-grass.
1929	8.7	..
1930	10.1	..
1931	11.3	..
1932	..	9.3
1933	..	8.2

It is readily conceded that such a comparison is not statistically sound, as the records, though for the same farm with a very even soil, are not replicated in the same season. However, the comparison does at least show that on light land where turnips are an uncertain crop a good winter carrying-capacity may be secured from an alternative crop—lupins with Italian rye-grass. As yet this latter crop is not subject to the diseases that play such havoc with turnips and swedes in some seasons. Further, in the dry autumn of 1933, when many turnip crops were a failure, this farmer had no difficulty in wintering his sheep without the use of large supplies of chaff and other supplementary feeds. On the other hand, where turnips can be grown with reasonable success, a portion of the turnip area can often be used profitably during the late autumn for fattening lambs. For this purpose lupins and Italian rye-grass, sown in February, are not well enough advanced and therefore would give a much lower carrying-capacity if used for fattening in, say, March and April. On this farm lupins and Italian rye-grass have not been tried for fattening lambs in the late autumn.

A question which arises is whether Italian rye-grass grown alone or lupins grown alone and rationed similarly would give the same winter carrying-capacity as when grown together. No records are available for either of these crops under these circumstances. Regarding Italian rye-grass it is a fact that over a period of thirty years or more it has not established itself in this capacity. Although a bulk of green lupins which is consumed by sheep must provide feed, at least of some value, yet this value may not be as great without some green grass as with it. Perhaps the health of sheep may not be as good on pure lupins as on a mixture of lupins and grass. These matters all require thorough investigation. In the experience of this farmer, however, the ewes were in good condition after having been wintered in the manner described. Information about the time of sowing lupins in relation to their susceptibility to frost has also to be obtained. Both crops of lupins and Italian rye-grass just described were sown during February, and no damage by frost occurred in either year. It must be remembered, however, that both the 1932 and 1933 autumns were comparatively dry and that the lupins did not reach the flowering stage until October. The belief that lupins are sometimes poisonous to stock has not been supported.

In conclusion, it must be stated that the experiences of this farmer are not necessarily in any way considered applicable to every or any particular Canterbury farm. They are, however, recorded in the hope that those farmers under similar conditions may have the opportunity of knowing what has been successful on at least one farm where cropping and short-rotation or temporary pastures only are desired. Other farmers are sowing lupins as described herein, but with permanent pastures, instead of with Italian rye-grass, and rationing the mixture to ewes for winter feed.

Special thanks are extended to Mr. W. R. Hammond, Winchmore, Ashburton, who, throughout a period of five years, has kept detailed records which make the relating of his experiences of some real value. Without them this article could not have been written.

APPENDIX.

TURNIPS.

The details of the 1929 turnip crop are:—

An area of 36 acres was ploughed in August, 1928, hustled four times, harrowed, rolled, and drilled. Imperial Green Globe at the rate of 10 oz. per acre was sown in mid-January, 1929. It received 1 cwt. of superphosphate per acre.

The feeding of the first break was commenced on 30th June, when 442 ewes were rationed for four hours daily. The details of grazing are—

1929—

30th June to 16th September	..	442 ewes grazed four hours daily.
26th July to 29th July	..	124 ewes grazed full time.
17th September to 18th September	..	227 ewes grazed full time.
18th September to 19th September	..	2 ewes grazed full time.
19th September to 20th September	..	225 ewes grazed full time.
20th September to 21st September	..	5 ewes grazed full time.
21st September to 23rd September	..	218 ewes grazed full time.
23rd September to 25th September	..	12 ewes grazed full time.

During the period 30th June to 16th September 36 acres of deteriorated pasture were used as a holding paddock. In this field, which contained a little roughage, the ewes were fed about $\frac{1}{2}$ lb. of hay per head per day. No hay was fed from the 16th September to the 25th September, during which time the ewes were put on to another field of pasture roughage. If from the 30th June to the 16th September the hay and pasture roughage are considered as equal to one-fifth of the daily ration of the ewes, then the carrying-capacity per acre of turnips alone may be calculated for a three-month period.

For the 1930 crop of turnips the following details are available:—

An area of 36 acres was sown with Imperial Green Globe at the rate of 10 oz. per acre in mid-January, 1930. It received 1 cwt. of superphosphate per acre.

This season, grazing was commenced on the 26th April and continued as follows:—

1930—

26th April to 5th May	..	99 ewes grazing full time.
6th May to 7th May	..	540 ewes grazing full time.
8th May to 12th May	..	99 ewes grazing full time.
12th May to 21st May	..	75 ewes grazing full time.
24th May to 31st May	..	75 ewes grazing full time.
1st June to 9th June	..	75 ewes grazing full time.
9th June to 12th June	..	44 ewes grazing full time.
17th June to 21st June	..	40 ewes grazing full time.
16th June to 16th July	..	547 ewes grazing three to five hours daily.
16th July to 14th August	..	471 ewes grazing three to five hours daily.
15th August to 1st September	..	438 ewes grazing three to five hours daily.

The turnips were finished on 1st September. During the period 16th June to 1st September the sheep had a run-out on to a 36-acre field of old grass which had grown a small amount of roughage. During the same period the ewes also received 73 sacks (24 to the ton) of oat-sheaf chaff and 76 sacks (40 to the ton) of wheat-straw chaff. This supplementary feed, along with a certain amount of roughage, is calculated to provide about 20 per cent. of the daily ration of each ewe during the period 16th June to 1st September.

The details of the 1931 crop of turnips are:—

An area of 36 acres, after being ploughed deeply, hustled three times, twitch-harrowed twice, rolled, and drilled, was sown with Imperial Green Globe at the rate of 12 oz. of seed per acre in mid-January, 1931. It received 1 cwt. of superphosphate per acre.

Grazing commenced on 1st May, using ewes and lambs which were being fattened. Winter grazing commenced on 1st July. Grazing was:—

1931:—

1st May to 9th May	..	50 sheep grazing full time.
9th May to 15th May	..	48 sheep grazing full time.
15th May to 18th May	..	102 sheep grazing full time.
18th May to 20th May	..	135 sheep grazing full time.

1931—continued.

20th May to 10th June	72 sheep grazing full time.
1st July to 4th July	460 ewes grazing three hours daily.
4th July to 19th July	439 ewes grazing three hours daily.
20th July to 22nd July	439 ewes grazing three hours daily.
22nd July to 24th August	533 ewes grazing full time, with run-out on to bare oat stubble.
24th August to 5th September ..	520 ewes grazing full time, with run-out on to bare oat stubble.
7th September	520 ewes grazing for five hours only.
7th September to 11th September	210 ewes grazing full time.
11th September to 13th September	435 ewes grazing full time.
13th September to 15th September	67 sheep grazing full time.
28th September to 29th September	140 ewes grazing full time.
29th September to 1st October ..	18 ewes and lambs grazing full time.
4th October to 21st October ..	65 sheep grazing full time.

During the grazing of this turnip crop the only supplementary feed provided was a run-off on to oat stubble from 1st July to 22nd July. By the end of this period the stubble was eaten out.

LUPINS AND ITALIAN RYE-GRASS.

Details of Stock Grazing.—The details for the winter of 1932 are as follow :—

1931 : 29th December to 8th January, 1932	249 lambs grazed full time on shedded lupin-seed and stubble.
1932 :—	
9th January to 14th January ..	86 sheep grazed full time on shedded lupin-seed and stubble.
19th April to 26th April ..	57 lambs grazing full time.
6th May to 30th May ..	12 sheep grazing full time.
18th June to 13th July ..	440 ewes grazing three to five hours daily.
13th July to 23rd August ..	486 ewes grazing three to five hours daily.
4th August to 5th September ..	124 ewes grazing full time.
28th August to 10th September	486 ewes grazing full time.

On 10th September 11 acres of the 37 acres was closed for seed. From 12th September the first breaks to be eaten off were used, firstly, for green feed for lambing and, secondly, for ordinary grazing. During the winter the ewes had a run-out on to a field of fair roughage, and were fed oat-sheaf chaff. This supplementary feed has been calculated to equal 25 per cent. of the daily ration of a ewe in the winter period, 18th June to 10th September.

The details of the 1933 crop of lupins and Italian rye-grass are :—

An area of 38 acres, having been ploughed in August, 1932, hustled four times, harrowed, drilled, and rolled, was sown with 2 bushels of lupins and 20 lb. of Italian rye-grass per acre on 14th February, 1933. It received 1 cwt. of superphosphate per acre.

The grazing details of this crop are :—

1933 :—	
11th June to 1st August	6 ewes grazing full time.
2nd July to 2nd September	440 ewes grazing four hours daily.
2nd September to 3rd September	435 ewes grazing four hours daily.
3rd September to 6th September	350 ewes grazing full time.
6th September to 9th September	260 ewes grazing full time.
9th September to 11th September	220 ewes grazing full time.
11th September to 13th September	201 ewes grazing full time.
13th September to 14th September	190 ewes grazing full time.
16th September to 17th September	203 ewes grazing full time.
17th September to 18th September	15 ewes grazing full time.
22nd September to 23rd September	143 ewes grazing full time.
23rd September to 25th September	11 ewes grazing full time.

The last break of lupins and Italian rye-grass was finished on 25th September. The first break to be fed off, which had about two months' growth of rye-grass, was again used as lambing-feed from mid-September. Allowance similar to that in previous years has been made for oat-sheaf chaff and holding-paddock grazing.

SIGNS OF HEALTH IN DOMESTIC ANIMALS.

C. V. DAYUS, District Superintendent, Live-stock Division, Department of Agriculture, Dunedin.

BEFORE it is possible to recognize any departure from health and apply appropriate treatment on logical lines, it is clearly necessary to have some conception as to what constitutes the normal healthy animal. In view of the fact that animals are unable to contribute any direct help, it is necessary to depend to a very marked degree on our powers of observation of the symptoms presented in forming a diagnosis. The daily observation of healthy animals and a sound practical knowledge of the feeding and rearing of live-stock constitute essential ground work to facilitate recognition of symptoms of disease.

WHAT IS HEALTH?

A question which arises is—What is health? Health may be defined briefly as that condition of the animal in which all the functions are performed normally. What one calls healthy or normal is simply what the most extensive experience has proved to be the commonest condition. This applies alike to the structure, functions, and chemistry of the body. So it is recognized that what is healthy or normal in animals of one species may not be so in other species. For example, a pulse-rate which is normal in the dog would be evidence of disease in a horse under identical circumstances and *vice versa*.

A healthy animal should eat, drink, and sleep well and regularly, and should be bright in manner. The posture should be normal and easy, disease being indicated by irregularities such as resting limbs, outstretched nose, pendulous ears or lips, inappetence, &c. Change of habits often indicates disease. The various functions must also be normal, such as the pulse, respiration, temperature—both internal and external—and excretions. Rumination in the case of ruminating animals should be regular, and the same applies to lactation in milk-yielding females.

THE PULSE.

The pulse is an expansion of an artery due to the rise of pressure as the result of each contraction of the heart. The pulse wave gives most valuable information as regards the state of the circulation; it gives one the rate of the heart's action and the strength of the various beats. The volume, tension, and form of the pulse can also be determined. Certain variations, uniform in all animals, occur in the pulse-rate. It is always much quicker in the young animal than in the adult. As the animal increases in age the pulse-rate drops, and in old age the pulsations are not only reduced in number, but are weaker. The pulse varies in character according to age, condition, and state of the system. The character is really more important than the actual number of beats. Variations in the pulse beyond certain limits are indications of some departure from health. As we recognize the vital importance of

the heart in sustaining life, we can appreciate the gravity of a weak, failing pulse. The pulse should be taken by the finger-tips on a medium-sized artery having a firm background.

In the horse the normal beat is 36 to 40 per minute. In the horse the pulse is best taken either at the submaxillary artery, where this vessel goes round the edge of the lower jaw-bone just forward of the angle of the jaw, or at the radial artery inside the elbow.

In cattle the normal beat is 45 to 50 per minute. In cattle the pulse is best taken at the radial artery, just below and at the back of the knee, or the coccygeal artery under the middle of the tail.

In sheep the pulse is somewhat variable, but averages between 70 and 80 beats per minute. It is easily taken at the femoral artery inside the thigh.

In the pig the pulse-rate also varies, but averages between 70 and 80 beats per minute. It is best taken at the femoral artery inside the thigh. It is not altogether easy to ascertain the pulse of the pig.

In the dog the pulse varies according to the breed, and ranges between 80 and 120 beats per minute. It is easily taken at the femoral artery inside the thigh. In judging its character it is essential that the dog should be quietly handled and not excited. An intermittent pulse is quite a normal condition in the dog.

RESPIRATION.

In health the chest-wall and the abdominal muscles should both take part in the respiratory effort, which should be regular and easy and free from any suggestion of jerkiness. The true character is most easily observed by watching the flank carefully while the animal is at rest before he is in any way disturbed. There is an approximate ratio in health of one respiration to four pulse beats. In diseased conditions this ratio is upset, and respirations may even exceed the number of pulse beats.

The average number of respirations per minute in the horse is 8 to 12, in cattle 12 to 16, in sheep in winter from 15 to 20, while in summer respirations may be very hurried and exceed 100 per minute. In the pig and dog there is a wide range, depending partly on age, breed, and excitability, and it ranges from 10 to 20 respiratory efforts per minute when at rest.

TEMPERATURE.

The external temperature is the temperature of the skin and extremities, and is maintained by the distribution of heat through the circulation. Therefore it depends on the circulation in the part of the body examined. Hence it may be an indication of the heart's action and its power to drive the blood through the skin and remote parts of the body. In estimating the external temperature, the hand should be passed over the surface of the body and also the ears, muzzle, and limbs of horses; the base of the horns, the muzzle, and limbs of cattle; the snout of swine; and the muzzle of dogs.

The internal temperature is a thermometric measurement of the heat of the blood. It is usually taken in the domestic animals per rectum with an ordinary clinical thermometer. Care must be taken always to shake the mercury of the clinical thermometer well below the normal temperature of the animal about to be tested, and the instrument should be greased a little and well inserted. The temperature of health may vary within certain limits in the same animal. The normal temperature of any animal is slightly raised after a meal, during rumination and lactation, and in pregnancy of females. Work also raises the temperature somewhat, consequently the normal temperature of the same animal is usually a little higher in the evening than in the morning. In young growing animals the temperature is usually a little higher than in animals in the prime of life.

Temperature above the normal range is usually considered a febrile temperature denoting a fevered condition. When the temperature is excessively low, or subnormal, it is called a "collapse" temperature. This often indicates the approach of death. The normal temperature in the horse is 100.4 degrees Fahrenheit. For comparison, the average normal temperature of man is 98.4 degrees Fahrenheit. In cattle the normal is 100 to 102.5 degrees Fahrenheit. In sheep the normal temperature is 101 to 104 degrees Fahrenheit. In the pig the normal is 101 to 102 degrees Fahrenheit, and in the dog 100 to 102 degrees Fahrenheit.

THE MUCOUS MEMBRANES.

Another helpful sign in regard to health is the appearance of the visible mucous membranes. Normally they are slightly moist and pink. Variations may occur in disease in each of those conditions. These membranes include the conjunctiva, which is exposed when the bottom eyelid is pulled down, and also the lining membrane of the nose and mouth. Variations in colour may be noted, due to the quantity and character of the blood circulating through the parts.

THE SKIN.

In health the skin should be soft and supple, and freely movable upon the underlying structures. The coat should also be glossy and resilient or elastic, and not present a harsh feeling to the touch. A staring coat, consisting of a dry harsh condition of the hair is a common indication of unthriftiness. The skin should not be hidebound, which is the term given to the condition in which the skin appears to be adherent closely to the subcutaneous structures, almost giving the impression of being too small for the body it covers. It is due to the arrest in the production of subcutaneous fat, and is therefore one of the results of malnutrition or emaciation from some wasting disease. In this condition it is impossible to raise the skin in folds as may be readily done in a well-nourished animal.

MISCELLANEOUS FEATURES.

In addition, in the case of the horse the general attitude and expression must be taken into account. In health the head is always on the alert, the eye is bright, full, and wide open. The

ears are alert and pricking to and fro. The fore feet are always square and firm on the ground, but one of the hind feet may be rested on the toe. It is noteworthy that the horse never rests a fore leg unless there is something the matter with it.

One of the main indications of health in cattle is the fact that there is constant leisurely chewing of the cud when at rest. Cattle spend about seven hours out of the twenty-four "chewing the cud." They generally commence this operation thirty to seventy-five minutes after a meal. Each "cud" is chewed thirty-five to fifty times by cattle according to the nature of its constituents. This occupies half a minute to $1\frac{1}{4}$ minutes, and then the cud is reswallowed. In from three to six seconds another "cud" has reached the mouth, and so the process continues.

In health there is a pronounced "dew" on the muzzle, the hair is licked up in places, the animal consorts with its fellows in the herd; if sick, the ox frequently separates itself from others.

Sheep in health are actively moving over country, feeding here and there or resting comfortably, leisurely chewing the cud. On opening the wool there is a healthy pinkish appearance of the skin, which is an indication of a thriving healthy animal. When disturbed healthy sheep rapidly move together; defective or sick animals separate themselves or lag behind the main mob.

The pig in health is always a free feeder, and ever looking for a meal. A healthy pig always has a curl in its tail, and frequently will be noted rubbing itself against a post or other convenient place.

The dog in health is bright, alert, intelligent, with a good glossy coat and a moist cold muzzle.

EXPERIMENTAL WORK ON THE CONTROL OF *PIERIS RAPAE* (WHITE BUTTERFLY) BY MEANS OF PARASITES.

The most important work that this section has had to deal with during the past year has been in connection with the biological control experiments on white butterfly. A survey in the field of the places where parasites had been liberated during the previous season indicated that the larval parasites (*Apanteles glomeratus*) were at work though they were not sufficiently prevalent to offer any serious check to an increase of the butterfly. The pupal parasite (*Pteromalus puparum*), on the other hand, was found to have spread considerably from its original point of liberation. During the present season further consignments of both larval and pupal butterfly parasites were imported and liberated. Four hundred and twenty-five thousand cocoons of the larval parasite were received from Farnham Royal, England, and from this material 240,000 parasites emerged and 5,000 hyperparasites. All of the latter on emergence were promptly destroyed. Two hundred and thirty thousand of the parasites which emerged were sent into the field. These were mainly concentrated in the Hawke's Bay locality, though a few were distributed in Gisborne, Tauranga, Taihape, Te Kuiti, and parts of the Manawatu district. From a brief survey of the Hawke's Bay locality, where the bulk of these parasites were liberated, only a small percentage of parasitized butterfly larvæ were obtained—not more than 3 per cent. were parasitized. It is not to be inferred from this, however, that these parasites are unsuccessful, as it often happens in biological control work that the insect which is the most difficult to establish subsequently proves the most effective.

With reference to the pupal parasites, namely *Pteromalus puparum*, 11,500 of these were distributed in the field, and again most of these were concentrated in the Hawke's Bay locality, though a few consignments were distributed in other places, including the Manawatu and Taihape districts. Of these 11,500 pupal

parasites liberated, 8,000 were reared at the Station. A recent survey in the Hawke's Bay District, where the main body of parasites was concentrated, indicates that they have become thoroughly established there and are doing good work. They have spread over hundreds of square miles of the Hawke's Bay territory, and there seems little doubt that they were at least partly, if not wholly, responsible for the large reduction in the prevalence of the butterflies in that district. In one survey it was found that, out of a total of 5,300 *Pieris rapae* pupæ collected at random in the field, 90 per cent. were parasitized. This work to date has been so successful that it has been deemed advisable to extend our activities to the extent of attempting to rear pupal parasites in very large numbers during the coming year in order, if possible, to be able to liberate them in selected localities throughout New Zealand where the butterfly is prevalent. The work is now proceeding very satisfactorily, and we have at present 20,000 butterfly pupæ for parasitizing, and it is expected that at least another 20,000 or 25,000 will be secured before the commencement of the coming season.

Apart from the biological control methods in connection with the control of the butterfly, a certain amount of information has been gathered from experiments conducted with chemical control methods. Out of a number of materials tried, the most successful control obtained was from the use of calcium-arsenate dust used in the proportions of 1 part of calcium arsenate to 5 parts of hydrated lime. This material, if dusted at the requisite intervals as required, gives an effective control of the pest. The method, however, is only suitable for garden use or for the commercial grower of cabbages and cauliflowers. It is not a method that can be economically adopted in general farming practice in this country.—*Report of Entomologist for year ended March, 1934.*

WOOL PRODUCTION.

Information as to production of wool is not obtainable directly; but it is possible to compute fairly accurate figures on the basis of exports and local consumption during the twelve months ended 30th June and the variation in stocks revealed by the annual census of stocks of wool held on 30th June.

In the following computation of total production, scoured, washed, and slipe wool has been converted to a greasy basis on the assumption of an average loss of 33½ per cent. in weight, while wool exported on skins has been taken at an average of 4 lb. per skin.

Year ended 30th June,					
	1930.	1931.	1932.	1933.	1934.
Million lb.					
Exports of wool	207·2	244·3	248·1	310·0	308·9
Exports of wool on skins ..	4·8	6·4	6·8	11·1	14·4
Acquired by New Zealand mills ..	6·1	6·2	7·0	6·6	6·0
	218·1	256·9	261·9	327·7	329·3
Variation in stocks	+54·8	+14·2	+20·9	-39·3	-28·8
Estimated production ..	272·9	271·1	282·8	288·4	300·5

Production for the year ended 30th June, 1934, shows an increase of 12·1 million lb. over the total production of 288·4 million lb. for the previous season. Contrary to anticipations early in the season, the yield per sheep shorn proved to be higher in 1933-34 than in 1932-33, and the position was further affected by a record lambing (with a greater number of lambs shorn), and by a later killing season. It is probable also that, with the much higher prices ruling for wool, farmers would endeavour to realize on their dead wool, crutchings, &c., to a greater extent than in immediately preceding years.—*Abstract of Statistics.*

AGRICULTURAL AND PASTORAL STATISTICS, 1933-34.

PRELIMINARY statistics for the season 1933-34 are now available, and figures for the principal items are here given, last year's final figures being shown also for purposes of comparison.

Attention is directed to the fact that the crop figures relate only to holdings of 1 acre or over located outside borough boundaries. The live-stock figures, on the other hand, include allowances made for live-stock in boroughs and on holdings of less than 1 acre in extent.

PRINCIPAL CROPS.

Name of Crop.	Areas.		Unit.	Yields.	
	1932-33.	1933-34.		1932-33.	1933-34.
Wheat—	Acres.	Acres.			
For threshing	302,531	286,285	Bushel	11,054,972	9,036,319
For chaff, hay, or ensilage	2,180	2,264	Ton	4,533	3,373
Fed off or cut for green fodder	1,213	6,457	..	..	..
Oats—					
For threshing	116,206	78,346	Bushel	5,132,183	3,242,564
For chaff, hay, or ensilage	259,294	218,195	Ton	453,503	357,957
Fed off or cut for green fodder	49,087	68,242	..	..	..
Barley—					
For threshing	16,336	21,024	Bushel	561,017	730,963
For chaff, hay, or ensilage	860	777	Ton	1,952	1,931
Fed off or cut for green fodder	6,280	7,803	..	..	..
Maize—					
For threshing	8,153	8,257	Bushel	389,432	373,228
For ensilage	636	448	Ton	5,088	3,601
Fed off or cut for green fodder	6,361	8,571	..	..	..
Peas for threshing	22,370	30,362	Bushel	585,418	698,293
Linseed for threshing	333	1,441	Cwt.	2,705	12,564
Potatoes	24,605	25,038	Ton	129,079	127,417
Onions	1,134	1,112	..	9,203	9,452
Rye-grass, harvested for seed—					
Perennial	68,992	38,989	Lb.	26,242,734	12,660,579
Italian and Western Wolds	17,932	6,941	..	9,696,743	2,503,012
Cocksfoot harvested for seed	11,293	9,496	..	2,335,497	724,684
Grasses and clovers cut for hay	409,974	378,183	Ton	762,146	690,957
Grasses and clovers cut for ensilage	116,495	92,271	..	467,596	369,002
Lucerne cut for hay or ensilage	35,867	35,906	..	106,095	107,182
Turnips (including turnips and rape mixed)	472,995	478,682	..	..	..
Mangolds	11,961	13,747	..	..	..
Tobacco	2,126	1,803	Lb.	1,784,676	1,239,946

—*Census and Statistics Office.*

There is no parochialism in agricultural research the world over. The information is broadcast and is available for whosoever will use it. New Zealand in the past has been particularly fortunate that this is so, and, while at the moment we may regard New Zealand as evolving towards strains in plants and animals that may be superior to the original importations, yet we must not close our eyes to the fact that agriculture the world over is progressing along scientific lines and the importation of new improved stocks may enable us to make even better use of the wonderful climate, soil, and talent we possess in the competitive race for agricultural supremacy. The importation of species and strains should go hand in hand with the improvement of our present-day species and strains.—*Report, Agrostologist.*

PIG-FEEDING EXPERIMENTS.

Groups of pigs from the same litter were fed after weaning, the one group on whole milk and the other on skim-milk of 0.15 per cent. fat content. Both groups were given meat-meal only as a supplement, but no green food. After three weeks, when they were settled on these foods and were growing well, *B. Suipestifer* was introduced by culture into both groups. The skim-milk group scoured badly, one died, and one became very ill but later recovered. This group was put back over 10 lb. on the average at this stage and did not catch up with the whole-milk group. This latter group did not show any effect whatever from the *Suipestifer* culture, for they grew well and were extraordinarily good pigs. At post-mortem the blood was found to be normal chemically in both groups, with no significant difference, there was a positive agglutination in all pigs to *B. Suipestifer* antigen, this being absent at the commencement of the experiment, and the organs were on the whole normal except in the heaviest and best pig of the whole-milk group, which had an ulcerated caecum. The protective power of the whole milk was therefore evident. Other experiments on these lines are being planned for the new year. Skim-milk was found to be almost entirely deficient in Vitamins A and D while whole milk contained twenty-eight units of Vitamin A per pint, a fair but not a high figure.

This shortage of Vitamin A in skim-milk is quite likely to be responsible for the trouble in young pigs, which ranges from alimentary and respiratory infection to nerve degeneration, ending in paralysis. Luckily feeding with materials rich in the accessory food factors offers no management difficulties.—*Annual Report, Wallaceville Veterinary Laboratory.*

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SEASONAL NOTES.

THE FARM.

Summer Top-dressing.

UNDER conditions typical in essential particulars of those obtaining in the main dairying districts, a limited number of dairy-farmers have carried out top-dressing in recent years with superphosphate on some of their pastures in late November or in early December. These farmers have been so satisfied with the results from such top-dressing that they intend to persevere with it. The tendency in this connection seems to be to prefer November to December top-dressing, partly because the farmer usually is not quite so busy in November as in December, and partly because there is a greater period in which the November dressing may make its influence felt before the advent of the relatively dry conditions that occur widely after mid-summer. From their experience the farmers say that the summer top-dressing increases appreciably the amount of fresh, leafy feed available in the latter part of the summer—this is most marked when the summer rainfall favours growth, but it also occurs under relatively dry conditions when any additional fresh, leafy growth generally is especially useful. The farmers' experience just cited relative to the increased summer supply of leafy feed is in complete accordance with the results of carefully conducted field trials which have been carried out for several years at Marton and Ruakura and which involve accurate weighing of the growth resulting from the various treatments. It is to be expected that, as the December-January rainfall decreases, summer top-dressing will decline in effectiveness as a means of obtaining additional fresh, leafy growth in late summer until a point is reached when it is probably not worth doing. The experience that recently phosphated pastures withstand conditions of relative drought in a more satisfactory manner than similar pastures which have not been phosphated is in agreement with much other field experience. Even if exceptional conditions, abnormally dry for the districts under consideration, obtain, the benefit from summer top-dressing with superphosphate merely is mostly deferred but not lost. The field experience under consideration relates to districts in which a December-January rainfall of at least 5 in. to 6 in. is normal, and has no reference to districts of really low summer rainfall.

Areas from which hay or silage have been saved usually respond profitably to a December application of superphosphate, which tends to increase the production of leafy feed at a season when it is frequently in scant supply.

Weaknesses in Summer Feeding of Stock.

Though farmers in general are more concerned about their shortcomings in respect to the winter feeding of stock, and though there is much scope for improvement in respect to winter feeding, there is probably just as much inefficient summer feeding as there is inefficient winter feeding of stock. And, unfortunately, some of the inefficiency in summer feeding cannot be as readily removed as the inefficiency in winter feeding.

Inefficient summer feeding is of two distinct types. In the first place, in early summer an important and a common weakness in the feeding of "wet" stock, including sows and ewes as well as dairy cows, lies in the quality as distinct from the quantity of the feed. On the other hand, for some weeks after midsummer while the supply of feed is sometimes deficient in quality, it is probably more often deficient in quantity. As the early summer weakness in respect to quality is to some extent interrelated with the later weakness in respect to quantity, the two conveniently may be considered together.

In practice, enough consideration does not seem to be given to the fact that the bulk or weight of such important summer crops as grass and clover, green lucerne, and green millet is very misleading as a measure of their feeding-value. The facts relative to grass and clovers exemplify in essential respects the position in regard to the other crops mentioned. The dry matter—*i.e.*, the residue after all water has been removed—of leafy pasture contains approximately twice as much phosphate and lime as the same amount of dry matter from corresponding herbage at the hay stage of growth; similarly it contains about two and a half times as much protein, and, further, about 80 per cent. of the dry matter of leafy herbage is digestible, whereas only from 40 to 50 per cent. of the dry matter of similar pasture in the hay stage is digestible. The practical importance of these facts is that the rations of "wet" stock frequently fall short of requirements in mineral matter which is required for bone and milk formation, in protein which is required for milk and flesh formation, and in digestibility—high or rapid production is necessarily linked with high digestibility.

A measure of the feeding-value of typical leafy pasture is the fact that its dry matter is practically identical with that of the standard concentrate, linseed cake. On the other hand, a substantial part of the dry matter of a stemmy or woody crop is analagous in nutritive value to sawdust and, further, dry matter of this sort affects detrimentally some of the remaining dry matter by making it less digestible. In brief, leafy grass and kindred feeds are essentially diluted high-class concentrates, whereas stemmy growth tends to belong to the inferior class of feed which is sometimes termed "roughage" or "coarse fodder."

The basic differences between leafy and stemmy pasture growth emphasize the need for management which as consistently and continuously as possible will beget leafy growth. This management consists primarily of the systematic grazing, ensilage, and "topping" which were described in some detail in these notes in the previous *Journal*. Further information directly applicable to specific circumstances is obtainable from local officers of the Fields Division.

It is of considerable moment that pasture-management which will provide the desirable leafy feed in November and December as a rule ensures a greater supply of such feed later on than results when pastures are allowed to become coarse and stemmy before midsummer; pastures which have been allowed to reach the reproductive stage of growth, as distinct from the leafy or vegetative stage, seem to exhaust themselves to some extent in doing so, and even when they are shortened by mowing or grazing, do not at once produce leafy growth so freely as swards which have been kept short throughout. But often they are not shortened, in part at least, and then the process of leaf-production is further delayed.

Because of considerations similar to those associated with pastures, such crops as lucerne, millet, and maize should as far as possible be utilized in the leafy stage. In this connection yield of feed deserves consideration. This applies in an important manner to lucerne because an important effect of repeated cuts of very leafy forage may readily be overlooked or accounted for incorrectly. Repeated cutting of immature growths of lucerne has been shown to be a drain on the plants, to lead to a rapid falling-off in yield and to a weakening of the lucerne plants, which is particularly likely to prove serious if the lucerne becomes invaded by other plants which outgrow it in winter and spring. Crops such as soft turnips, millet, and maize can be grown to meet any deficiency in leafy feed from pastures after midsummer, but if work relative to these is not already well forward then it becomes necessary to depend largely upon the aftermath from ensilage and hay paddocks and the maintenance of the pastures generally in a leafy condition by control of the growth through grazing and topping, and when this is the case grazing management becomes of vital importance. In seeking suitable

control of pasture growth just prior to midsummer, it is advisable to avoid grazing so closely that the pastures suffer on the advent of the dry, hot period that customarily occurs in many districts—it is probably wiser to have the pasture growth tending towards being too long instead of too short just before the expected advent of dry conditions during which it is desirable that the surface of the land be covered as completely as possible with vegetation. To sum up, much of the very common weakness in the feeding of "wet" stock in summer is to a large extent a grazing management weakness, and the measures which correct the weakness in quality in early summer help at the same time in remedying the weak position that commonly obtains after midsummer. To avoid drying out and scant production of pastures during dry summer conditions, care should be taken not to graze closely just prior to the expected advent of these conditions.

Control of pastures in summer is obtained much easier if swards are characterized by even growth. Regular and thorough distribution of droppings of cattle and horses by means of harrowing valuably assist in securing such even growth. It is advisable to try to avoid harrowing just before a dry spell, for it is preferable that the soiling of the feed which harrowing at times causes be removed by rain.

Haymaking.

From the foregoing facts about the feeding-value of the growth of pastures at different stages of development it may be deduced that when haymaking is practicable it is a mistake to postpone cutting hay crops until the heaviest possible crop is obtained. While a few extra hundred-weights may be harvested from an acre, many hundredweights of feed are deteriorating seriously. Further, the later the haymaking the more are naturally sward-forming species likely to be affected detrimentally and the less is the likelihood of the quick production of a prolific aftermath.

But because of weather conditions haymaking is at times not practicable when the hay crop is at the most suitable stage of growth for harvesting. This fact provides the basic and the sound cause of the popularity of ensilage in the main dairying districts. The advantages of mowing at the leafy stage of the bulk of the hay crop are so great that they well justify special measures to save hay in a good condition before it has become undesirably stemmy and mature. Cocking is one of these measures; over much of the Dominion it is seldom possible to save a heavy crop of hay at the right stage of growth and in good condition without cocking. In this connection it is interesting that inquiries disclose that practically all the hay exhibited successfully at shows has resulted from cocking. To many, but not to all, it is unnecessary to point out that a hay-cock should not be a mere heap. A hay-cock should be well-hearted and raked and efficiently built so that it will shed much rain and be wet only on the outside. Cocking is particularly useful in the securing of lucerne and clover hay of good quality.

If rainy and broken weather occurs immediately after mowing then, within reasonable limits, the mown material should not be handled until fine weather seems to have returned; handling of mown material increases the facility with which nutriment is washed out by rain. If there seems to be likelihood of bad weather, cocking should be hastened—the amount of leaching corresponds with the amount of rain which washes the material and the amount of rain which falls on the area occupied by the cocks is but a fraction of the amount which falls on the area occupied by the swathes.

Ensilage.

Some common faults in ensilage were discussed in these notes last month. Much further information is contained in Bulletin 146 obtainable free on application to the Department of Agriculture.

In general there is a proper place for both haymaking and ensilage on many farms which restrict their attention to one of these practices. Ensilage

should be carried on when weather is bad or uncertain, as it is more likely to be early in the season; but when good weather prevails haymaking usually should be adopted in preference to ensilage. Provided hay can be saved in first-class condition, there is as a rule no practical consideration which justifies handling the extra weight of material involved in ensilage. A possible exception to this would be a crop invaded by weeds such as thistles which in the form of silage is likely to be more edible to stock than as hay. One consideration which warrants the saving of both hay and silage is that on most farms special crops such as mangels and swedes should find a place and hay of good quality is generally a better companion feed to crops of this type than is silage.

General Cropping Work.

To some extent the appearance of seedlings of weeds in crops such as mangels, potatoes, carrots, &c., may really be a blessing in disguise—it compels attention to cultivation. Cultivation at times seems to be looked upon primarily as a means of keeping weeds in check and hence as a matter calling for action only when weeds are becoming troublesome. Actually the suppression of weeds is only one of several benefits resulting from cultivation. The general value of the cultivation that produces a fine firm seed bed is widely known although the knowledge is far from universally reflected in practice. But it is not so generally known that suitable cultivation subsequent to seed-sowing ensures better results from judicious expenditure on seed and manures and assists the crop in withstanding, without injury, a spell of dry weather which would cause a setback to a similar crop poorly cultivated. At this season one of the most important aspects of forage cropping is the neglect of cultivation. This applies not only to preparatory cultivation, but to intertillage of growing crops sown in rows wide enough to allow of it even though weeds are not disagreeably prominent.

Often in December, hand in hand with tillage goes the work of thinning and weeding of crops sown in October and November—work which is made easier by prior hoeing along the rows. The best time to do thinning is as soon as the seedlings are of sufficient size to allow of the plants being handled without difficulty. Undue delay in thinning not only tends to stunt the crop, but also makes the work of thinning more difficult.

Maize and millet to provide green feed usually are sown successfully in November or December. Good results have been obtained by sowing maize broadcast at the rate of 75 lb. of seed an acre and covering the seed by a very shallow ploughing; disking may be employed as an alternative to such ploughing. Sowing millet at the rate of 15 lb. to 20 lb. of seed an acre has consistently given good results. Almost invariably both crops respond profitably to a dressing of superphosphate at the rate of 1 cwt. to 2 cwt. an acre, and unless the soil is highly fertile it is usually profitable to include also some nitrogenous material in the manurial dressing.

Over wide areas good results may be expected from sowing the important swede crop in December at the rate of 10 oz. to 14 oz. per acre of seed through every second coulters of an ordinary grain-drill, but sowing through every coulters has also given good results and especially in the South Island sowing in ridges followed by intertillage is widely practised and has consistently given heavy crops. A fine, firm seed bed favours a good "strike" of swedes. A popular practice is to apply about 3 cwt. an acre of manure of which phosphate is the dominant constituent. When the seed is mixed with the manure for sowing, injury to the seeds through bringing them in contact even for a short period with soluble manures such as superphosphate, sulphate of ammonia, and potash salts should be avoided. The injury caused by superphosphate can be obviated by

mixing the superphosphate with an equal weight of ground limestone (carbonate) about a week before sowing. The mixture usually sets hard to some extent and so should not be bagged until it has been made two or three days when it may be pulverized easily in the heap. Among the progressive farmers who participate in crop competitions the popularity of varieties of swedes varies considerably from district to district. In the North Island generally Superlative Grandmaster and Majestic are widely used, while in Southland Elephant and Masterpiece find favour. These selections of farmers are in general accord with work relative to varieties done by the Department.

Chou moellier maintains its deserved popularity. This is because of its marked resistance to clubroot, its good feeding-value, its consistently satisfactory yields, while calling for relatively little labour and the ease of feeding it without undue waste especially in wet-soil conditions. In its requirements relative to fertility chou moellier parallels the cabbage, and soils not naturally of high fertility must be suitably reinforced by liberal dressings of farmyard or artificial manure to produce good crops of chou moellier. Normally superphosphate should be prominent in the fertilizer applied to chou moellier. December sowings are suitable for the production of winter feed. A suitable sowing is $1\frac{1}{2}$ lb. to 2 lb. an acre broadcast or $\frac{1}{2}$ lb. to $\frac{3}{4}$ lb. an acre in drills 2 ft. to $2\frac{1}{2}$ ft. apart.

As a rule, satisfactory results from spraying for the purpose of controlling potato-blight are obtained only when spraying is commenced early enough to serve as a preventive instead of as a cure—spraying in December is likely to be of distinct preventive value. If spraying is not proper in respect to either the materials or the methods employed, then it is likely either to damage the crop treated or to be ineffective against the disease. Full information about spraying may be obtained from local officers of the Department.

—R. P. Connell, *Fields Division, Palmerston North.*

THE ORCHARD.

Control of Pests and Diseases.

SPRAYING operations recommended in these notes for September and October last should be continued for the control of powdery mildew, black-spot, pear-scab, codling moth, leaf-roller caterpillar, leaf-hopper, &c. on pome-fruit trees, and on stone-fruit trees for the control of brown-rot, aphid, leaf-rust, and other diseases. The strength of lime-sulphur in the combination spray should be reduced to 0.083 per cent. from about the middle of December for apples. The tender varieties such as Cox's Orange, Sturmer, and Dunns should receive the weaker strength in all sprays after the "petal fall" application. For pears it is advisable to continue spraying with bordeaux-mixture 3-4-50 plus arsenate of lead $1\frac{1}{2}$ -100, as recommended in the September notes, for the control of pear-scab, codling moth, leech, &c. From the time these notes are published, applications should be made at intervals of fourteen to twenty-one days. In those localities, however, subject to fogs or heavy dews, or in ones in which there is a succession of wet days, the period between the spray applications should be reduced accordingly. Thoroughness of application to all parts of the tree and its appendages is of the utmost importance and becomes increasingly difficult to secure as the season advances and the foliage becomes more dense. If a high pressure is maintained a good coverage of all tree parts is more readily obtained.

All apple-trees that are subject to attack by powdery mildew should be examined at least twice while the trees are growing and all infected shoots cut out and destroyed. This practice is essential, at least in certain localities, for the satisfactory control of powdery mildew.

Thinning of Pome Fruits.

Thinning is an operation that consists of removing from the tree all undesirable fruit before it attains any appreciable size. Apart from the removal of diseased or otherwise injured fruit, this operation should be delayed until after the natural dropping which takes place about the second week in December. One object of thinning is to leave on the trees only the number of fruits that the tree can develop to a good marketable size, and in so doing arrange for the fruit to be evenly distributed over all tree parts. Another object is to prevent a wastage of tree energy by removing all fruits that will not be of a good marketable value when fully matured, such as fruits infected with black-spot or pear-scab, or injured with bronze-beetle or other insects. Fruits allowed to remain should be thinned so that no two will be touching when fully grown, provided there are sufficient fruits set to permit of this being done without reducing the crop excessively. If single fruits only are retained the control of insects such as leaf-roller caterpillar, bronze beetle, and codling moth is much more readily effected.

Grafts.

All trees that have been grafted during the present season should be examined frequently. Where good growth has been made, the binding can now be cut. This is best done by drawing a sharp knife from top to bottom of the binding, and this as far distant from the scion as possible. It is not necessary or even advisable to further remove the binding which is still affording the union a certain amount of protection. Shoot growth from the stock should not be allowed to overcrowd the scion and should be checked periodically by pinching back.

Cultivation.

The maintenance of a good tilth by frequent cultivation should on no account be neglected. Good cultivation not only maintains soil aeration, but helps to retain moisture, and generally provides conditions suitable for maximum crop and tree growth.

Cases.

An ample supply of fruit-cases for the coming season if not already attended to should be arranged for immediately, and its delivery made not later than December. This will permit of the cases being made up prior to the busy period of harvesting and provides for a final seasoning of the timber, if such should be found necessary.

Miscellaneous.

Machine graders, lidding-presses, wiring-machines, &c., should all be overhauled at an early date to ensure that everything is in perfect order for the commencement of the packing season. Orchard ladders, picking-bags, &c., will need an examination to see that they are ready for the busy harvesting period. Packing-materials can be ordered now so as to make certain that supplies will be on hand when required, and generally everything possible should be done to lessen the rush of work usually associated with the commencement of harvesting.

—P. Everett, Orchard Instructor, Gisborne.

Citrus Notes.

In those localities where citrus trees have blossomed heavily, indicating a heavy crop of fruit, it will be necessary for the grower to realize he has a most important part to play in bringing that crop to maturity, and that this can be accomplished only by an additional application of some nitrogenous fertilizer, such as nitrate of soda or sulphate of ammonia, the quantity being regulated by the age and size of the tree and the amount of fruit that is promising.

The trees will have benefited greatly by the recent rains, and every effort should now be made to conserve moisture by lightly forking the top soil round each tree. Good tillage plays an important part in the development of the crop.

The treatment of young trees should not be neglected and all shoots starting low down on the stem should be removed. Strong perpendicular shoots which are not required for the framework of the tree should be cut back to induce side growth, and those wanted for the formation lightly tipped to ensure stability.

As indicated in the previous month's notes, a further spraying with Bordeaux 3-4-50 is necessary if verrucosis and scab is to be controlled. As the adult borers will now be on the wing, a careful lookout should be kept for any evidence of their working, and where small twigs are infected they should be immediately removed, and the larger limbs may be treated by the injection of benzine in to the holes and plugging with soap or putty. All ends of broken limbs should be cut to smooth wood, leaving no rough places on which the adult insect may lay her eggs.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Summer Management.

NEXT month is usually one of the most trying months of the year, particularly in regard to the developing stock. It is, therefore, a time which calls for the greatest care and thought on the part of the poultry-keeper in studying the requirements of the young birds and making the conditions as ideal as possible and thereby minimizing the risk of the young ones receiving a set-back during the hot weather. In the first place, they should be provided with an abundance of nourishing food. For the production of well-developed bodies and bone of the right quality and thickness, there is no food equal to good plump oats. Given whole, it is difficult at times to get the birds to eat them, but trouble in this respect may be minimized by purchasing oats that are clipped, or better still, shelled. One should not neglect to give the birds an adequate supply of freshly broken oyster or other sea-shell, the lack of which is one of the causes of leg-weakness and kindred troubles which affect birds during their developing period.

The approach of the hot weather will specially direct attention to the necessity for the fowls receiving plenty of green material. This important item is overlooked on many plants, but it is all the more necessary where the birds are confined to the house or small runs. Green feed serves a threefold purpose, for it not only tends to promote good health and an increased egg yield, but also gives the yolks of eggs the desired rich colour, and a decidedly better flavour, while, further, it materially assists in reducing the grain bill and thereby makes for economic production. There is nothing better than young tender grass. Usually, however, as the season advances, any green material in the runs becomes too tough and fibrous for the birds to relish it, so that where birds are kept in confinement, and especially in bare runs, it is imperative for the maintenance of a healthy thriving state that other green food must be supplied. Silver-beet is an excellent plant to grow for poultry of all ages, and is a heavy cropper. Experience over a period of years at the Wallaceville Poultry Station goes to show that growing chickens relish silver-beet better than any other green material that can be grown on the place. Any of the cabbage family, including rape, or, alternatively, mangolds, carrots, and green oats, may be grown to advantage. A fact it is desired to emphasize is that for growing stock to make the best growth they must never receive a set-back, and one

of the worst checks to healthy development is lack of green feed during the growing stage. No effort should be spared, therefore, to grow now an abundant supply of green material for future use. Never, under present conditions, should an attempt be made to rear weaklings or deformed stock. They should never be persevered with, and it is far better to destroy them at the outset and thereby save the worry of trying to rear birds which if they do come to maturity may never pay for their keep. Remember that it is the weakly constitutioned bird which is apt to catch every passing ailment and may thus be the means of introducing serious trouble into the flock.

If the chickens being reared by artificial means are becoming weak in the legs and developing a wobbly walk, or an unsteady gait, it indicates they are crowding by night and require more warmth. The huddling effort has the effect of spreading and weakening the delicate legs. On the first sign of this condition being observed, additional warmth should be applied, but, above all, see to it that the chickens are not subjected to draughts. The latter may easily occur where brooders of the canopy type are used. In working this class of brooder, provision for the admittance of an ample supply of fresh air is imperative, but this must be provided without draughts. If there is a draught, from any particular quarter, the chicks will gradually move away from it even if it means leaving the chief source of heat so essential for their welfare, rather than remain in a draught, and when this occurs the chicks feel the need of warmth, with the result that they huddle together, each trying to secure an inside position, which is necessarily the warmest, the delicate legs spread, and the chickens become unable to walk. This trouble is intensified when the floor of the brooder is of a smooth nature, as the constant slipping on this soon injures the legs. Chickens affected with this trouble may give every indication of being quite healthy, except for the loss of leg-power, but in most cases it will be better to destroy them than to try and doctor them. The removal of the cause of the trouble is the only safe course to adopt. The first step in this connection is to supply the desired warmth in order that the chickens may be comfortable and may spread out over the floor of the brooder; also plenty of bedding-material should be provided. As a further preventive, a board or pieces of tin, say 15 in. in height should be placed on the floor of the house, say a foot away from the brooder, as a draught break. If the behaviour of the chicks is observed it will soon be possible to detect from which direction the draught is coming and the boards or tin used can be placed to break the draught.

It is not generally known that the lack of animal food is a common cause of brooder chicks acquiring the habit of toe picking and other cannibalistic habits. As a preventive of these troubles, the chicks should be provided regularly with animal food, but it is better not to feed it at all than to feed it only at odd periods. What the chickens never had they never miss, but if once they discover the taste of meat they crave for more, which is evidenced by the fact that they commence to eat each other.

It is common when a number of cockrels are running together for them to commence sparring and fighting, often with serious results. Many a promising sire has been ruined from no other cause. A good plan is to put one or more adult males with them. This will tend to keep peace among the young birds and prevent them from injuring each other.

The Mother Hen.

Where the natural mother is being used for hatching and rearing chickens, a common but mistaken practice is to put the chicks hatched from two or more hens with one mother. This is satisfactory when poor hatches are obtained, and the numbers are not excessive, but to put twenty or more chickens with one mother is not a sound practice. It is true that the hen may rear the majority of them, or even all, but it cannot be expected that they will make such sound development as where the number has been reduced.

What applies in this case applies in equal or greater force where an excessive number of incubator hatched chicks are placed under a hen for the purpose of being reared. A case in point recently came under notice where two dozen day-old chicks were purchased and placed under one hen, obviously, from the outset, the young birds failed to thrive, and later the majority died. The owner of the chicks was disinclined to take any blame whatever for his loss in this respect, but was convinced that this should be solely attached to the breeder from whom the chicks were purchased, for sending out weakly constitutioned stock. It should always be remembered that it is more profitable to rear a few chickens properly than many indifferently.

When a broody hen is being used for mothering artificially produced chicks, it will be wise to allow her to sit on the nest for at least ten days before giving her the care of the young birds. As a general rule, the longer the hen is allowed to remain broody—up till say, three weeks—the better she mothers the incubator-hatched chicks. To give a hen charge of the young birds only a day or two after her broody period has commenced invariably means that the hen does not take kindly to them, and as a result the chicks get chilled while furthermore the hen will probably resume laying in a short time, and cease to mother the chicks properly until they are able to look after themselves.

—F. C. Brown, *Chief Poultry Instructor, Wellington.*

THE APIARY.

Requeening.

THE most important bee within the hive is the queen, and it is useless to expect a colony to be productive unless she is a good one. It is therefore highly essential that all colonies should be headed with prolific queens of a good strain if vigorous workers are to be raised. Queen-rearing is an important adjunct in apiary-management, and unless provision is made to requeen systematically the beekeeper will find dwindling colonies and diminished crops. Where practicable, it is advisable to requeen the colonies every year. Exception, however, must be made in the case of hives containing breeding-queens, and others retained on account of desirable drones.

Where the operations of the beekeeper are such as to prevent annual requeening, provision should be made to replace half the queens in the apiary each year. If this plan is followed no colony will have queens more than two years old. With the aid of a few nuclei young queens can easily be hatched and mated, but in many cases—especially where a swarm has emerged from a hive—virgin queens can be secured and form an easy solution of the requeening problem.

No better plan can be followed by the beginner than to utilize queen-cells produced naturally—that is, under the swarming impulse. It has been proved that in New Zealand the best months for raising queens are from November to January. During this period everything is favourable to the operation, as the hives are at their highest state of prosperity. Under normal conditions the workers and drones are at their best, this being the swarming period. There is practically no risk of robbing; the young queens are readily accepted, and will tend to reduce swarming. Moreover, a queen introduced during the months of prosperity will produce numbers of young bees for the winter, and still be fairly young in the following spring. In the case of after-swarms, these may be sifted through an excluder placed between two empty supers, when the queen or queens can be removed. The bees will then return to the parent hive.

These young queens can be utilized for starting nuclei. It always seems a pity to destroy the young vigorous queens bred under the swarming influence, and wherever there is an opportunity they should be saved and failing queens destroyed. A handy method of introducing virgin queens is by the smoke method. The old queen must first be removed from the hive that is to be requeened. The entrance then is contracted, and a few vigorous puffs of smoke are forced in through it. Then, before the bees have recovered from this treatment, the virgin queen is released at the entrance, piloted into the now queenless hive, and hastened therein by several more puffs of thick smoke. The hive is then closed altogether for about ten minutes, after which the entrance is once more opened slightly and left like this till the next day, when the full entrance can once more be allowed.

Extracting Preparations and Practice.

Preparations for extracting the honey must now be well in hand. By the time these notes are published the main flow should have started in the North, but it will depend entirely upon weather conditions. In the South the flow is fully three weeks later, and extracting rarely commences before the New Year.

It is well to get all the arrangements for handling the crop completed before the honey is sealed and ready for the extractor. It does not take a great deal of time to prepare extra supers and frames, but these are of inestimable value to the beekeeper when the main flow commences. Every year immense quantities of honey are lost through lack of proper gear for handling the crop, or through the unreadiness of the beekeeper when the hives are full of honey. It is poor economy to keep one's supply so low that the bees hang about outside the hive and loaf for want of combs in which to store the honey.

Room should be provided for the workers as soon as the first honey is capped, either by extracting the combs or by supplying them with another super. Keeping the extractor running from the beginning of the honey-flow till the end is good beekeeping, provided the honey is not extracted while in an unripe condition. Although some authorities advocate leaving all the honey until the end of the season—thereby building colonies three and four stories high—the result is rather heavy work, and this method is, in any case, not advisable in southern localities. Where the summer is short and variable the risk of getting the honey chilled by leaving it in the hives until the end of the season is too great. Honey, except in a few instances, is best extracted when warm from the hives. In fact, where there is any tendency to "thick" honey, extracting while the honey is warm is the only way to obviate breaking the combs in the extractor.

Comb-honey should be treated in the same way. All sections should be removed from the hives as soon as they are filled. This makes them less liable to be daubed with the propolis and to become "travel-stained" by the constant passage of the bees.

The extractor, tank, and all the rest of the gear connected with the handling of honey should be scalded and thoroughly dried before commencing the season's work. Honey, by reason of its peculiar method of production, does not call for the daily cleansing required by other foods, but it behoves the beekeeper to see that his honey-house is as trim as hands can make it. After the extractor has been scalded it should be kept covered with a clean washing cover when not in actual use, and every receptacle containing honey should receive the same treatment. These covers are easily made and washed, are inexpensive, and add much to the condition of honey as an article of food. No bees, flies, or any extraneous matter should be allowed to touch the honey once it leaves

the extractor, and from the time the bees gather it till it leaves the beekeeper's hands for market his aim should be to produce a dainty and attractive article of food.

Extracting Appliances.

It is useless trying to work bees profitably without proper appliances. These consist of an extractor, uncapping-knives, uncapping-can, and settling-tanks. Many beekeepers make the mistake of trying to get along with any makeshifts, but experience will teach that it is a poor policy to endeavour to operate without an up-to-date equipment. However small the number of hives kept, if extracting is the objective it will be found to be most profitable to install a four-frame machine. Costing a little more at the initial outlay, it will soon pay for itself in labour-saving, and enable the beekeeper to meet the biggest flow. In any case he should not be persuaded to purchase a machine that will not reverse. Fixed machines are labour-makers, besides being messy in working. When fifty or more colonies are worked it will be found that a power plant pays for itself over and over again.

Second in importance is a good tank. No apiary equipment is complete without one or two good tanks. Too little attention is paid to maturing the honey out of the hive, and freeing it from the minute particles of wax which float on its surface. It must be left to the beekeeper to decide the size of tank he requires, this depending on his needs and conveniences.

For rapid working two ordinary uncapping-knives are very convenient, but as yet no better invention has been given to the beekeeping world than the steam-heated knife. This knife obviates the necessity of constantly dipping the cold knives into hot water, and the work of uncapping can proceed uninterruptedly. There are several uncapping-cans and melters on the market, most of which are relatively satisfactory, but the perfect capping-melter has yet to be invented.

Treatment of Disease.

If the weather conditions have not been favourable for the treatment of foul-brood, such treatment should be undertaken when the first opportunity occurs. It is inadvisable to delay until the main flow arrives—if colonies are treated early enough a surplus of honey will be secured and the expense of treatment recovered. Handling clean bees is a constant source of delight, but diseased bees are a never-ending cause of trouble. Full particulars of the treatment of foul-brood are given in Bulletin No. 119 "American Foul-brood and its Treatment," which can be obtained from the Department of Agriculture, Wellington, or from the Apiary Instructors in each centre.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

THE month of December is a busy time among the vegetable crops. As land is released by the harvesting of early crops, a late sowing of dwarf beans, peas, shorthorn carrots, globe beet, turnips, radish, spinach, and lettuce should be sown when the land can be caught in nice moist condition without being sticky.

After clearing the ground and hoeing the surface well, plant supplies of any of the following winter crops: savoy and red cabbage, kale, broccoli, cauliflower, leeks, and celery. Good plants that are neither drawn, stunted or soft should be well watered a day or so before planting out in dull weather

or during the afternoon. This is work which should not be done roughly, but with the greatest consideration. Lift the plants carefully, place them in seed-trays for conveyance to the planting-ground, exposing them to the sun and wind as little as possible. Plant them rather deeply, firm carefully, and water them in usually, especially the leeks and celery. In exposed positions it is sometimes an advantage to plant in a shallow furrow.

It is well to realize there is a considerable battle imminent soon after these crops are planted out. White butterfly, diamond-back moth caterpillars, and green aphid usually launch a strong attack on the crops belonging to the cabbage family; while celery crops are often seriously damaged by the attack of leaf-spot fungus. The insect pests are particularly troublesome in fine dry weather when plant growth may be slow and mortality among the insects is low. Close attention is then necessary to protect the plants over the period of dry weather, after which the danger is not so great, especially from diamond-back moth and the aphides, which will possibly altogether disappear. To protect the young plants from the attack of caterpillars dust them with powdered arsenate of lead one part thoroughly mixed with five parts of air-slaked burnt lime, applying it during the evening or early morning when a light dew is on the plants. Green aphides, which are perhaps the more serious pest, give their attention chiefly to the bud in the centre of the plant, causing the tender leaves to curl in a way that affords them shelter and makes treatment difficult. At the first sign of attack a little tobacco dust placed in the heart of each plant will make the position distasteful for the pest and migrating insects will go elsewhere to establish their colonies. The celery crop is protected from the attack of leaf-spot fungus by spraying with bordeaux mixture as described in last month's notes.

Reference was made last month to the harvesting of asparagus and the permanent injury done to the plantation by prolonging the cutting season beyond the usual eight or nine weeks. The results of cutting new plantations at different ages and for various periods has been demonstrated by Lewis, of Illinois, in a seven-year experiment recently concluded. Eighteen plots were planted out in the permanent field in 1926. The outstanding results for the seven years since the plants were set are as follows: A. Plots cut for two weeks the first year after planting (1927), four weeks in 1928, and the full period of eight weeks annually since totalled 431.51 lb. weight of spears for the seven years. The crop for the last year of the experiment was 133.1 lb. B. Plots not cut the first year after planting (1927), but cut for two weeks the second year and four weeks the third year, with a full cutting period of eight weeks annually since, produced 531.53 lb. weight of spears. The crop for the last year of the experiment was 169.4 lb. C. Plots not cut for the first two years after planting (1927-28) and cut for four weeks the third year, six weeks the fourth year, and a full period of eight weeks for the remaining three years of the experiment, produced 467.86 lb. The crop for the last year of the experiment was 151.5 lb. In this experiment the treatment given to the B series of plots gave the best return, C and A treatments following in that order. Plot A came first in the total number of spears cut, as is to be expected, plots B and C following in that order; but for the last year of the experiment the order was B, C, A, the same as for total weight. That order was also maintained for the number of first-grade spears; while B plots produced the fewest "strings" (third-grade spears), and A plots the most. For average weight of individual spears the plots remain in the same order, B, C, A. This comprehensive experiment carried out over a period of seven years indicates a light second year cutting of asparagus plantations may be advisable.

Comparatively heavy first-year cutting was included in the experiment (four weeks and six weeks), but the crop fell off badly, and permanent injury

is indicated. A four-week cutting the second year was also demonstrated, but the results are inferior to the C series of plots and little better than the A series; it is evidently a practice not to be recommended.

Tomato Crops.

Fortunately for this crop under glass, extremely high temperatures are unusual in this country, and a buoyant atmosphere is readily obtained where attention is given to ventilators at all times as necessary. A low barometer in a humid climate is probably the most difficult condition for this crop, and facilities for adequately ventilating all parts of the glasshouse are necessary if leaf-mould disease is to be controlled under such conditions.

As regards the virus diseases such as "mosaic" and "stripe," much depends on the constitution of the plants. If the constitution is undermined by a badly drained soil or poorly balanced feeding, the trouble may easily be serious, while similar infection in a well-managed crop may cause comparatively little loss. It is now well established that these diseases are often transmitted through the seed, either the embryo or seed coat, so every effort should be made to save seed only from a crop that is quite free from such diseases.

The extraordinary number of plants being added to the list of those that are hosts of the "spotted-wilt" disease which also affects this crop, makes it necessary to keep a general supervision on most classes of plants growing in the vicinity, including the weeds, which should be consistently suppressed. Also thrips and sucking insects, especially those of the more active kinds, which are the chief agents for the distribution of such troubles. It is well to remember they are most numerous and active in dry warm seasons and localities.

The Homestead Garden.

Where new gardens have to be made the work is best commenced in early autumn when the ground is sufficiently moist for trenching or ploughing. When the soil is thoroughly clean and deeply cultivated, lawns may be sown and planting done. Then the best results are obtained quickly if the design is well proportioned and the trees and shrubs carefully selected and arranged.

To do this satisfactorily the undertaking requires consideration, which should be given it now, so that a definite plan is ready when the time for action arrives. The plan for the layout need not be elaborate, but should be to scale, as also should be the arrangement of the planting.

During the spring we have had groups of the Chatham Island lily in sheltered shady positions making a fine display of blue flowers and handsome foliage. In a good moist loam the kowhai makes a light graceful tree, and the quality of its ample yellow blossom has made it a general favourite. The kaka beak—sometimes called kowhai—red, pink, and white, is making a display on sloping banks where its pendulous flowers are seen to advantage. On almost every hand a mantle of the starry white blossoms of the native clematis has been spread on the boughs of evergreen trees to remind us that October is here. In the most exposed places veronicas, red, blue, and white, grow best, and are now taking their place in the procession. These and other native flowering-plants, together with our tree ferns and palms, should receive the consideration of every planter; as should the great number of handsome native evergreens which are not to be excelled for the purposes of shelter under many conditions, and provide the necessary setting without which the brighter flowering plants lose half their beauty. Not that exotic trees and shrubs should be ignored; such a setting as is mentioned above is ideal for the hydrangeas, which have been so improved during recent years, and provide a generous display when most shrubs have passed their blossoming season. What is to be said of rhododendrons and azaleas which flower here in a manner which

is probably unsurpassed in any country? It is rare to see these grouped to best advantage in semi-shade where they thrive best; a good deal of consideration is necessary to do this effectively.

The chief difficulty in this problem is the "embarrassment of riches" provided by the long list of good things available and the rather natural desire to plant a specimen of each, so far as possible; with the result that the garden loses the repose and brightness which should be its outstanding qualities. Restraint is essential to good design. If this rule is observed when planning garden-planting there will be less variety and rather larger grouping, especially in the smaller subjects. The resulting effect should far outweigh any sacrifice of variety that has been made.

Alterations as well as new gardens should be planned now.

—W. C. Hyde, *Horticulturist*, Wellington.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

COLDS IN PULLETS.

C. R. R., Te Tuhi, Hawke's Bay:—

Twelve pullets are affected with eye trouble. As a rule only one eye is affected, but sometimes both. Sometimes the eye is light-grey with a film, but more often it has a bloodshot look and is very covered with film, inflamed, and tender. Some hens in an advanced stage are quite blind in one eye. I have isolated the birds, and have tried a lotion with boracic and sulphate of zinc, but with no effect.

The Live-stock Division:—

The birds are suffering from roup, due to a neglected cold. Colds are most commonly caused through compelling the birds to sleep in an ill-ventilated or draughty house, while exposure to rain, and damp, overcrowded quarters are often responsible. There are so many things which may be responsible for fowls catching cold, the forerunner of roup, that it is usually necessary to look for the cause in several quarters. Even where the modern, deep, partly open-fronted, lean-to style of house is provided, the poultry-keeper must be always on the alert to make sure that, while good ventilation is provided, the birds are not sleeping in a draught. Even one small crack close to where a bird is roosting may cause much trouble. Prevention in dealing with colds is always better than remedial treatment; but when colds have made their appearance, treatment may be found necessary. Prompt measures should be taken, for too often the neglected cold, as previously indicated, develops into the dangerous roup. When this stage has been reached, little or nothing can be done for the bird, and usually the best course is to kill it and burn the carcass. A little Condly's fluid placed in the drinking-water, sufficient to give it a rich pink colour, will generally prove effective in checking the trouble.

MARE PREMATURELY SECRETING MILK.

T. M. W., Warkworth:—

A nine-year-old mare due to foal in three months has quite a show of milk. On her back legs you can notice where there appears to be milk or scum dripping from her udder. The mare is in good condition and does no work at all. She appears quite healthy, and trots around the paddock.

The Live-stock Division:—

This will sometimes happen in extraordinary cases, and if her udder is much distended it would be better to relieve it. Is there any sign that she has cast her foal? If so, then she would secrete milk.

USE OF OLD DIPPING FLUID.

S. P. B., Fairlie :—

Dip is in a reasonably clean condition and has been standing in the bath since last April. Would it be harmful if used for dipping sheep a second time now? The fluid has not been polluted in any way, save for the dipping of a certain number of sheep just before the winter. Would standing so long tend to weaken it and, if so, to what extent?

The Live-stock Division :—

One cannot recommend the use of this dip. During the time it has been standing deterioration must have taken place, also dilution by rain-water, &c.; and, further, the fact that the excrement—*i.e.*, dung and urine from the previously dipped sheep—has been in the dip for so long must have caused pollution.

DISCHARGE AFTER DEHORNING.

W. H., Helensville :—

One of several heifers which were dehorned last April has failed to heal on one side, from which there is a discharge of thick white fluid. What treatment should I give it?

The Live-stock Division :—

One can do very little for this except to syringe out the cavity with any antiseptic solution every day. I would advise you to use hydrogen peroxide diluted with warm water, one of the peroxide to three of the water. Do this daily for a time, and if there is no improvement after a fortnight's treatment it might be better to fatten and sell the heifer.

MACROCARPA POSTS.

W. H. S., Wanganui :—

(1) Is it necessary to season macrocarpa posts before using? (2) Is it necessary to take off the bark; and will it cause the "heart" to rot if the sapwood is left on saplings and branches? (3) Will macrocarpa sapwood last out of the ground?

The State Forest Service :—

(1) It is unnecessary to season posts of any species before using. If posts are seasoned they immediately reabsorb moisture from the damp earth in which they are placed, and no merit, therefore, attaches to seasoning before use. (2) To obtain the best life out of posts, it is necessary to remove the bark and sapwood. The sapwood of all species is non-durable, and will quickly rot in the ground. It may not necessarily affect the heartwood, but will certainly not aid its preservation. (3) Whether or not macrocarpa sap will last out of the ground depends entirely on the conditions under which it is used; and, in general, it can be stated that the sapwood of this species is not superior to that of other species in this respect. Sapwood out of the ground in dry locations may last for a long period of years, but, as stated, conditions of its use will govern its durability.

DURABILITY OF BIRCH POSTS.

A. H., Gisborne :—

I understand that for fencing-posts one of our birch (beech) trees is almost as durable as totara.

The State Forest Service :—

Red-beech (*Nothofagus fusca*) is the most durable beech species for fencing-posts, but it is not considered by any means as durable as totara (*Podocarpus totara*).

WEATHER RECORDS: OCTOBER, 1934.

Dominion Meteorological Office.

NOTES FOR OCTOBER.

With the exception of the first two days, October was very mild and equable. There was much less westerly wind than usual at this time of year. Conditions are rather dry in the eastern portions of the North Island, but in Nelson, Marlborough, and Canterbury the subsoil is thoroughly soaked for the first time during the last four to five years. Over the rest of the country, though rainfall has been on the light side so far this year, there is no acute shortage. On the whole, October was one of the best spring months we have had. There has been a wonderful flush of growth in grass and vegetation generally, and the countryside has never looked greener. Stock are in good condition, although in some districts lambs have not thriven as well as might be expected. The prospects for fruit and other crops are very good. Some trouble has been experienced in parts of Canterbury and Marlborough from excessive moisture.

Rainfall.—In Taranaki, Western Wellington, Nelson, Marlborough, and Canterbury rains were, in general, much above the average, though there were a few exceptions. Wellington City and much of Marlborough had double the normal total. In Westland the falls were for the most part about average. The remainder of the country received much less than is usual in October.

Temperatures.—After the 2nd, the month was a very mild one with no prolonged or severe spell of cold southerly wind. Nevertheless, mean temperatures were almost everywhere below normal. The departures were fairly large on the east coast but very small on the west.

Sunshine.—As regards sunshine, conditions were very irregular. Considerable departures from the average were recorded at numbers of places, but excesses and deficits appear to be about equally mixed. Lake Tekapo had 246.5 hours, Napier 226.1, Tauranga 215.5, and Blenheim 211.7.

Storm Systems.—The only storm of note occurred at the beginning of the month. At this time a depression was crossing the Dominion, and on the morning of the 2nd a deep cyclone centre developed over the Cook Strait area. Rain was practically general, and in the western and central districts there were many heavy falls. Flooding occurred in Taranaki, Southern Wellington, Marlborough, and North Canterbury. On the 1st, northerly gales raged at many places from Nelson and Marlborough northwards, and the Wairarapa experienced the most destructive gale in its history. The reason why this wind was so damaging is not very clear, since, in the higher levels, and at Wellington, for instance, stronger blows have been recorded. It must, however, have descended with unusual force to the low levels after crossing the Tararua Ranges. Such a descent is favoured if the ground is unusually warm, and the fact that the night of the 30th September to 1st October was unusually warm at Wellington while a very high maximum temperature was recorded at Masterton is in accordance with this. A strong southerly wind and a sharp cold snap followed on the 2nd October, and snow fell to low levels on the ranges.

A moderate westerly depression which passed on the 9th was also responsible for a fresh fall of snow on the ranges, but the precipitation caused by it was far from general.

On the 12th, another depression moved on to the country, and, its further movement being checked by an intense anticyclone to the eastward, did not disappear until the 16th. During this time rain fell in all parts, but was particularly heavy on the mountains and in western districts.

Several other depressions passed during the month, but none was very boisterous or productive of general rain. Associated with one of these there were some severe thunder and hail storms in western districts of the North Island on the 31st.

RAINFALLS FOR OCTOBER, 1934, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Rainfall.	Total for Year to Date.	Average for Year to Date.
<i>North Island.</i>						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	5.12	14	1.87	5.27	53.69	48.93
Russell	2.38	8	1.25	3.98	69.44	45.17
Whangarei	3.26	17	1.00	4.76	54.31	54.71
Auckland	2.17	14	0.75	3.72	39.99	38.68
Hamilton	2.90	15	1.00	4.60	36.26	42.03
Rotorua	4.42	17	1.17	5.27	43.57	47.10
Kawhia	4.71	18	1.20	5.15	41.22	45.90
New Plymouth ..	6.94	17	2.19	5.48	46.51	50.80
Riversdale, Inglewood ..	11.56	19	4.46	10.41	71.60	87.57
Whangamomona ..	12.99	13	2.90	8.43	57.22	64.53
Hawera	3.42	12	0.72	4.65	33.54	38.18
Tairua	3.43	10	1.15	5.81	49.61	56.44
Tauranga	3.23	13	0.73	5.26	47.75	45.55
Maraehako Station, Opotiki	2.50	10	0.72	5.35	38.52	47.29
Gisborne	1.09	10	0.53	2.67	23.31	39.95
Taupo	2.61	17	1.56	4.31	34.66	37.43
Napier	1.67	13	0.33	2.19	24.50	30.41
Hastings	1.54	13	0.43	2.11	21.38	28.16
Whakarara Station	1.74	9	0.51	..	41.31	..
Taihape	2.39	17	0.42	3.60	25.75	30.22
Masterton	2.04	10	0.83	3.28	30.03	32.94
Patea	6.21	..	..	4.25	35.53	37.28
Wanganui	3.43	13	1.07	3.46	29.17	30.18
Foxton	5.41	14	0.88	2.94	29.18	26.67
Wellington	6.85	14	2.23	3.41	41.13	35.34
<i>South Island.</i>						
Westport	9.48	22	1.31	8.70	76.86	79.50
Greymouth	11.25	20	3.90	10.74	82.44	83.80
Hokitika	10.62	19	2.69	11.86	82.43	94.11
Ross	..	..	..	14.77	..	109.58
Arthur's Pass	19.08	10	4.70	20.33	142.09	131.69
Okuru, South Westland	9.84	12	2.70	15.21	..	120.90
Collingwood	9.35	17	1.97	10.08	81.37	82.03
Nelson	6.20	13	1.51	3.51	32.82	31.93
Spring Creek, Blenheim	5.49	10	1.43	2.56	29.17	25.79
Seddon	4.76	10	1.55	2.23	26.73	20.99
Hanmer Springs	5.02	10	1.42	3.93	46.47	37.90
Highfield, Waiata	3.81	9	0.88	2.60	33.00	28.12
Gore Bay	3.55	13	0.82	2.33	35.76	26.58
Christchurch	0.96	10	0.26	1.75	24.81	20.94
Timaru	2.92	10	0.73	1.95	24.25	18.30
Lambrook Station, Fairlie	3.55	9	0.91	2.06	27.26	20.37
Benmore Station, Clearburn	2.90	13	0.77	2.30	22.45	20.25
Oamaru	2.62	13	0.70	1.76	22.33	17.84
Queenstown	2.36	7	1.01	3.37	29.95	25.16
Clyde	0.91	5	0.29	1.62	14.79	12.12
Dunedin	1.83	12	0.69	3.10	37.02	30.03
Wendon	1.16	8	0.29	2.73	23.88	24.42
Balclutha	0.84	11	0.21	2.42	28.06	20.58
Invercargill	2.53	17	0.80	4.42	34.58	37.30
Puysegur Point	5.62	17	1.65	8.13	59.24	69.84
Half-moon Bay	2.73	19	0.47	5.16	40.96	48.10